IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

CAPELLA PHOTONICS, INC. Plaintiff, v. FUJITSU NETWORK COMMUNICATIONS, INC., Defendant.	Case No. 2:20-cv-00076-JRG
CAPELLA PHOTONICS, INC. Plaintiff, v. INFINERA CORPORATION, TELLABS, INC., TELLABS OPERATIONS INC., CORIANT AMERICA INC., and CORIANT (USA) INC., Defendants.	Case No. 2:20-cv-00077-JRG

DECLARATION OF CHRISTOPHER L. WANGER IN SUPPORT OF PLAINTIFF CAPELLA PHOTONICS, INC.'S MOTION TO STRIKE DEFENDANTS' EXPERT REPORT OF MICHAEL S. LEBBY

I, Christopher L. Wanger, declare and state as follows:

1. I am a partner with Manatt, Phelps & Phillips, LLP, attorneys for plaintiff Capella Photonics, Inc. in the above-captioned action. Unless otherwise stated, I have personal knowledge of the facts set forth herein.

2. Attached hereto, as **Exhibit 1**, is a true and correct copy (without appendices) of the Expert Report of Michael S. Lebby Regarding Invalidity of Asserted Claims of U.S. Patent Nos. RE47,905 and RE47,906, dated March 15, 2021, served in connection with the above-captioned actions.

3. Attached hereto, as **Exhibit 2**, is a true and correct copy of Defendants' Initial Invalidity Contentions (without appendices), dated August 20, 2020, served in connection with *Capella Photonics, Inc. v. Infinera Corporation*, Civil Action No: 220-cv-00077-JRG.

4. Attached hereto, as **Exhibit 3**, is a true and correct copy of Fujitsu Network Communications, Inc.'s Initial Invalidity Contentions (without appendices), dated September 25, 2020, served in connection with *Capella Photonics, Inc. v. Fujitsu Network Communications, Inc.*, Civil Action No: 220-cv-00076-JRG.

I declare under penalty of perjury of the laws of the United States that the foregoing is true and correct.

Executed on April 26, 2021 at Mill Valley, California.

/s/ Christopher L. Wanger
Christopher L. Wanger

CERTIFICATE OF SERVICE

The undersigned hereby certifies that the foregoing document was served on all counsel of record who have consented to electronic service on this 26th day of April, 2021.

/s/ Robert D. Becker
Robert D. Becker

EXHIBIT 1

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

CAPELLA PHOTONICS, INC.	§	
	§	
v.	§	CASE NO. 2:20-CV-0076-JRG
	§	
FUJITSU NETWORK COMMUNICATIONS, INC.	§	

CAPELLA PHOTONICS, INC.	§	
	§	
v.	§	CASE NO. 2:20-CV-0077-JRG
	§	
INFINERA CORPORATION, ET AL.	§	

EXPERT REPORT OF MICHAEL S. LEBBY REGARDING INVALIDITY OF ASSERTED CLAIMS OF U.S. PATENT NOS. RE47,905 and RE47,906

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I. INTRODUCTION AND QUALIFICATIONS

1. My name is Michael S. Lebby, and I have been retained as an expert by (1) Infinera Corporation, Tellabs, Inc., Tellabs Operations Inc., Coriant America Inc., and Coriant (USA) Inc. (collectively, "Infinera"), in connection with Capella Photonics, Inc. v. Infinera Corp., et al., Case No. 2:20-CV-0077-JRG (E.D. Tex.) and (2) Fujitsu Network Communications, Inc. ("FNC" and together with Infinera, "Defendants"), in connection with Capella Photonics, Inc. v. Fujitsu Network Communications, Inc., Case No. 2:20-CV-0076-JRG (E.D. Tex.).

2. In this report, I set forth my current opinions regarding the following patents (the "Asserted Patents"), including the validity of their claims (the "Asserted Claims"): Claims 23–29, 31–35, 37, 39, and 44–54 of U.S. Patent No. RE47,905 (the "'905 Patent"); and Claims 68–72, 79–85, 87–92, 96–100, 106, 115–118, 122–127, 129–135, and 137–139 of U.S. Patent No. RE47,906 (the "'906 Patent"). This report also provides the bases and reasons for those opinions. I may offer additional opinions based on further review of materials in this case, including opinions and/or testimony of other witnesses.

3. Below, I have summarized my educational background, career history, publications, and other relevant qualifications. My full *curriculum vitae* is attached as Appendix A to this report.

A. Career and Educational Background

4. I am currently the CEO of Lightwave Logic, a company engaged in developing novel polymer modulators devices.

5. I am also the CEO and CTO of Oculi LLC, where I perform expert witness consulting concerning electronics, photonics, optoelectronics, semiconductors, and communications equipment technology. I am also currently a technical expert for the Photonics

Unit of the European Commission, where I participate in organizing workshops and lectures, evaluating photonics proposals and advising the European Commission on projects. I was voted the Photonic Integrated Circuits Conference Entrepreneur and Business Leader of the Year in March 2018. In 2020, I was elected as Fellow of the National Academy of Inventors.

6. Over my 35-year career in network communications, I have worked in nearly every aspect of electronic and fiber optics, including both electronic and fiber optic equipment and apparatuses. Accordingly, I have experience and expertise relating to design and development of connectorized electronic and fiber optic modules for rack-mounted equipment such as enclosures and housings, fiber optic connectors (*e.g.*, multi-fiber, SC, LC, and MT connectors), fiber management technologies (*e.g.*, cassettes, cartridges), fused fiber couplers, fiber optic transceiver modules, and fiber tray-based technologies (*e.g.*, couplers, splitters, amplifiers). I have also worked with optical switching technologies such as MEMs, LCDs, LCoS, and other technologies that can redirect and physically manipulate light.

7. I am a chartered engineer in the United Kingdom, which is a status equivalent to a United States professional engineer. I started my career in 1977 at the Ministry of Defense (United Kingdom) in the Royal Electrical and Mechanical Engineers (REME) division as a telecommunications apprentice. At the Ministry of Defense in Malvern, UK as known as the Royal Radar and Signals Establishment (RSRE), I also studied material and characterization issues of Gallium Arsenide (GaAs) and Indium Phosphide (InP) optoelectronic devices as well as semiconductor device design, fabrication, and characterization, and particularly with materials using III-V semiconductors. I also worked on ceramic-based radio-frequency (RF) electronic packaging that included low-temperature co-fired ceramic.

8. I attended the University of Bradford, where I obtained a Bachelor of Engineering (Electrical Engineering), with honors, in 1984, an MBA in 1985, and a Ph.D. (Electrical Engineering) in 1987. My Ph.D. thesis related to the characterization and fabrication of both optoelectronic and electronic semiconductor devices. In 2004, I was awarded a Doctor of Engineering (a Doctorate degree higher than a Ph.D.) from the University of Bradford for my "Technical Contributions to Optoelectronics." This was only the second time in the University of Bradford's history that a Doctor of Engineering was granted based on industry experience. The focus of the optoelectronics was fiber optics and in particular, fiber optic materials, devices, packages, connectors, and fiber equipment. Much of the submitted work for the higher doctorate was undertaken at AT&T Bell Laboratories (electronic and fiber optic devices), Motorola (electronics, electrical networking, fiber optic materials, devices, packages, connectors, and equipment), Intel (electronics, network communications, fiber optic equipment, devices, packages, connectors, and transceiver modules), and Ignis Optics (fiber optic devices, packages, connectors, transceiver modules, and line cards).

9. At the same time I attended the University of Bradford and afterward from 1985 to 1989, I worked as a researcher in the Photonics Research Department of AT&T Bell Labs ("Bell Labs"). At Bell Labs, I focused my research on novel device designs using III-V semiconductor material systems that included FETs, bipolar transistors, LEDs, laser diodes, and photodetectors. My research at Bell Labs became the subject of my Ph.D. thesis that included work on fiber optic materials (GaAs, InP) as well as their associated device designs (laser, LED, photodetector, etc.), and their design for networking equipment for AT&T. One of the projects included an optical switch for fiber optic applications.

10. After I completed my Ph.D. at the University of Bradford and my work at AT&T Bell Labs, I became a Research and Development Manager ("R&D Manager") in the photonics division of Motorola's Corporate R&D Labs ("Motorola") from 1989 to 1998. My responsibilities at Motorola included research and development of networking interconnects, displays, LEDs and laser devices as well as the packaging and reliability of mobile product prototypes. While at Motorola, I was the inventor or co-inventor of over 150 utility patents. In 1998, I received a special award from the Chairman of Motorola for exemplary patent accomplishments. At that time, I had the highest number of issued utility patents in the history of Motorola.

11. As an R&D Manager at Motorola, I worked on a number of projects, including the initiation of Motorola's work in optical and electrical interconnect technology and specifically, development of the Optobus™ product, which was a parallel fiber module for rack-mounted fiber optic equipment that utilized connectors such as LC and SC connectors and fiber optic transceiver modules. I was also involved in research and development of the integrated circuit chip designs that this module utilized as well as development of a new parallel fiber optic connector, which was a precursor to the MPO connector. In this project both single fiber and multifiber connectors were designed with a connector company and prototypes were produced and presented to standards committees for review.

12. A number of connector styles were investigated including the SC, LC, RJ, MT, MU and MTRJ to name a few. There were a number of connector designs that were patented at Motorola to promote improvements in size, weight and power at the time. In the early 1990s, both fiber optic and electrical networking was looking for ways to increase traffic through higher data rates.

13. In 1998, I left Motorola to join AMP/Tyco Electronics (now, TE Connectivity) as Director of Technology and Business Development, where I helped develop technology strategy for optical communications products for the Global Optoelectronics Division. I joined AMP/Tyco Electronics to specifically further the business relating to both electronics components for communications as well as fiber optic modules, trays, cassettes, adapter plates, and connector technology that served customers using fiber optic enclosures and housings mounted on standard 19-inch and 23-inch racks. I also worked with fused fiber couplers commonly used in fiber optic trays and racks utilizing fiber management technologies such as cassettes and cartridges. During the late 1990s there were a number of competing connector types and standards, and AMP/Tyco Electronics had their own proprietary designs of products such as fiber connectors, adapter plates, cassettes etc. While their business focused on proprietary designs, AMP/Tyco Electronics fiber products also utilized licensed and standardized connector styles such as the RJ45, MTRJ, MPO, LC, and the older more accepted standard of the SC connector. The fiber-based product development I worked on at AMP/Tyco Electronics needed to be aware and include solutions that would utilize not only AMP/Tyco Electronic designs but connectors from other companies and standards. SC, MT-RJ, RJ45 and LC based (to name a few) fiber optic and electronic modules were designed and sold using data rates of 1Gbps in the mid to late 1990s. These included data rates of 10Mbps, 100Mbps, and 1000Mbps or 1Gbps. Sometime these data rates can be called 10/100 and 100/1000 indicating two different data rates utilized in the system.

14. In 1999, I joined Intel Capital ("Intel") as Director of Business Development, and also as a corporate investor. My work at Intel included sourcing, negotiating, and closing private placement equity deals in the optical and electrical networking, component, and

semiconductor industries, including investments for Intel in a number of companies utilizing fiber optic connectors, pluggable transceivers, fiber tray-based technologies such as couplers, splitters, and amplifiers, and electronic assemblies for data networking. I also was one of the founders of Intel's silicon photonics division, which worked to establish a fabrication facility in South San Jose to investigate the integration of silicon Field Effect Transistor (FET) electronics with optoelectronics into the same silicon semiconductor wafer.

15. In 2001, I founded and became the President and CEO of Ignis Optics, a venture-backed startup company. At Ignis Optics, I developed pluggable LC and SC connector transceivers, which included fiber optic connecters utilized in fiber optic racks with trays, faceplates, and line cards. I also oversaw the testing of fiber optic connectors, modules, and fibers which were used in standardized rack-mounted units. Ignis Optics was a pioneer of SFP (Small Form Factor Pluggable) modules that operated at 2.5Gbps and 10Gbps data rates. At the time, the high performance, low power fiber optic solutions were industry leading. By 2003, Ignis Optics was acquired by Bookham Inc, (which later renamed Oclaro, now acquired by Lumentum Inc) to further advance the design of the 10Gbps fiber optic products.

16. From 2003 to 2005, I was the Vice President of Technology and Business Development for OCLARO, a San Jose, California-based company focusing on telecommunications optoelectronic components. At OCLARO, I oversaw the company's technology strategy as it related to the components and subsystems for telecommunications equipment, including fiber optic equipment.

17. From 2005 to 2010, I became the Executive Director, President, and CEO of the Optoelectronic Industry Development Association (OIDA), a trade association that represented

photonics manufacturers in the fields of fiber optic equipment, display, sensing, defense, aerospace, LED lighting and motor vehicles.

18. I joined Glyndŵr University from 2013 to 2015 as a Professor of Optoelectronics, where I focused on the design, simulation and testing of 100G/400G photonic integrated circuits, optoelectronic integrated circuits, laser diodes, optics and solar cells.

19. From 2013 to 2015, I was also the President and CEO of OneChip Photonics Corporation, where I served as an elected independent board member focusing on the technical and business operational strategy for communications based on InP photonic integrated circuits and optoelectronic integrated circuits.

20. Over the course of my career, I have also given a number of peer-reviewed presentations, speeches, and talks at workshops and conferences, including on fiber optic equipment and associated electronic and optical components. I also have designed optical interconnects, be they with fiber optics, semiconductor waveguides, polymer waveguides, dielectric waveguides, etc. I have also design experience with electronic components, both active (such as transistors, ICs, microcontrollers etc.), as well as passive (inductors, capacitors, filters etc.). I have also designed electrical interconnects that can be operated at direct current (DC), as well as alternating current (AC), and higher speed such as radio frequency (RF) and microwave performances. I have also designed RF and microwave circuits for various substrate platforms and designed optimum ways to interconnect and disconnect to those platforms. Given the high frequency nature of the designs, I am familiar with noise/EMI suppression, cross-talk, and other electrical influences that may degrade product performance. I have also designed packages that are essentially boxes that surround the electrical and optical devices and allow interconnection from the outside world down to the chip level. In many of these designs, the

interconnect can be permanent (fixed) or it can provide a disconnect function. These boxes are usually tested for their RF performance, and I have had experience in dealing with these issues.

21. My work with optoelectronics and electronics has also included the electronic ICs that surround the devices such as laser driver ICs, LED driver ICs, transimpedance amplifiers, microcontrollers, and other associated circuitry that enables functionality with devices such as lasers, LEDs, displays, and photodetectors. I have experience with power transfer systems such as those that conduct both electrical and optical signaling through connectors and other connect/disconnect interfaces both at the low current (milliamperes), low optical power (milliwatts) level as well as at the heavy current (amperes), and high optical power (watts) level. I have worked with both AC and DC current systems, and I am familiar with IC chip technology, including how ICs are interconnected, programmed, coded, and used in electronic circuitry. I am also familiar with both optical and electrical signaling in system applications that use ICs and connecting/disconnecting functions.

22. Additionally, I have experience with electrical connectors, and I understand the significance of wiring and light design for industrial and fiber-optic based products, including the engineering, design and manufacture of such products (e.g., the mechanical and electrical aspects of optimized RF and EMI designs). I am familiar with the design considerations of electronic connectors for data communications and telecommunications applications, including consumer product safety issues, fire hazard issues, mechanical design constraints, electrical design constraints, RF performance, electrical shielding and other design considerations. In particular, my experience in the fields of optoelectronics and electronics allows me to understand the structure and functionality of electronic connectors, including male and female

connectors, jacks etc., and how such connectors can be utilized in data communication and telecommunication products.

B. Patents, Publications, and Presentations

23. I have authored numerous publications and given seminars on topics in the field of optoelectronics, electronics, and photonics. My publications generally deal with the major issues in fiber optic network communications and components such as increased data rate (or speed of communication), lower power operation (to reduce power consumption), fiber density (through multifiber approaches for sources, detectors, connectors and optical sub-assemblies), and size (small more miniature solutions to allow for improved integration of technology).

24. I am a named inventor of over 200 issued patents or published patent applications from the USPTO, as set forth more fully in my CV.

C. Materials Considered

25. A list of the materials that I have considered in forming the opinions that are expressed in this report is provided in this report and in Appendix B.

D. Compensation

26. For time spent in connection with this matter, I am being compensated in the amount of $450.00 per hour, in addition to reasonable reimbursable costs and expenses. My compensation is independent of my findings or conclusions or the outcome of this case.

II. SUMMARY OF OPINIONS

27. A high-level summary of my opinions regarding the Asserted Patents is provided below. As discussed throughout this report, I have concluded that each of the Asserted Claims is invalid for multiple, independent reasons.

A. The Asserted Claims Are Invalid as Obvious in View of Prior Art

28. It is my opinion that each of the Asserted Claims are anticipated and/or rendered obvious by the prior art under 35 U.S.C. 103.[1]

B. The Asserted Claims Are Invalid for Lack of Written Description

29. It is my opinion that claims 23–29, 31–35, 37, 39, and 44–54 of the '905 Patent and claims 68–72, 79–85, 87–92, 96–100, 106, 115–118, 122–127, 129–135, and 137–139 of the '906 Patent are invalid for lack of written description under pre-AIA 35 U.S.C. § 112, ¶ 1.

III. UNDERSTANDING OF THE APPLICABLE LAW

30. I am not an attorney and will not offer opinions on the law. However, I have been provided an understanding of several principles concerning the validity of patent claims which have guided me in arriving at my stated conclusions in this report.

A. Invalidity Due to Lack of Written Description

31. I understand that a patent must contain a written description of the claimed invention that is sufficient to convey to one of ordinary skill in the art that the inventor had possession of the claimed invention at the time the inventor filed the patent application. I understand that this is legally referred to as the "written description" requirement.

32. I understand that the written description must actually or inherently disclose each and every element of a claim for that claim to meet the written description requirement, and that

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[1] It is my understanding that the America Invents Act (AIA) modified the statutory bases governing a patent's validity, including 35 U.S.C. §§ 102, 103, and 112, for patents with certain priority claims for September 16, 2012 or later. Given that the earliest possible priority date for the Asserted Claims is March 19, 2001 (as explained below in Section VI), my analysis utilizes my understanding of the pre-AIA versions of these statutory sections, which uses a first-to-invent criteria.

it is legally insufficient that undisclosed subject matter would have been obvious to a person of ordinary skill in the art.

33. Moreover, I understand that the written description requirement cannot be satisfied if the specification expresses a mere wish or plan for obtaining the claimed invention.

34. I understand that the specification must provide a written description for the full scope of the claims. I understand that it is unnecessary for a patentee to spell out every detail of the alleged invention in the specification, and that the patentee need include only enough detail to convince a POSITA that the patentee actually possessed the invention.

35. However, I also understand that a patentee cannot always satisfy the written description requirement for expansive claim language by merely, for example, describing one embodiment of the thing claimed.

36. I also understand that a broad claim is invalid when the entirety of the specification clearly indicates that the invention is of much narrower scope.

37. I understand that compliance with the written description requirement is assessed with respect to the application as it was filed, not the patent as issued.

B. Claim Construction

38. I understand that claim terms are generally given their ordinary and customary meaning, which is the meaning that the term would have had to a person of ordinary skill in the art in question at the time of the alleged invention, which I understand is commonly referred to as the *Phillips* standard.[2] I further understand that the person of ordinary skill in the art is deemed

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[2] I understand that, in many cases, the United States Patent and Trademark Office and the Patent Trial and Appeal Board apply or have applied a different claim construction standard: the broadest reasonable interpretation. I understand that the broadest reasonable interpretation standard is generally not used in

to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification.

39. In construing the meaning of a disputed term, it is my understanding that one should look at (1) the words of the claims themselves, (2) the specification, (3) the prosecution history, and (4) extrinsic evidence concerning relevant scientific and engineering principles, the meaning of technical terms, and the state of the art. I further understand that each of those sources of meaning should be accorded a decreasing amount of weight in the order listed, with extrinsic evidence being accorded the least amount of weight because such evidence is generally less reliable than the patent and its prosecution history in determining how to read claim terms.

1. <u>Dependent Claims</u>

40. I understand that patent claims constitute either independent or dependent claims. I also understand that the scope of an independent claim is determined separately from other claims.

41. I understand that a claim in dependent form must be construed to incorporate by reference all the limitations of the claim (or claims) from which it depends.

42. I understand that a claim in dependent form must specify a further limitation of the subject matter claimed in the claim (or claims) from which it depends.

2. <u>Preamble as a Claim Limitation</u>

43. I understand that a term in the preamble of a claim may be construed as a claim limitation if the term gives life and meaning to the claim. I further understand that a term in a preamble may be construed as a claim limitation if, in light of the specification, construing the

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district courts. My opinions do not utilize the broadest reasonable interpretation standard; they instead utilize the *Phillips* standard described above.

term as a limitation is required to limit the scope of the claim to what the inventors actually invented. I further understand that the preamble may limit the claim if the applicant relied on language in the preamble to overcome a rejection during prosecution.

C. The "Clear and Convincing Evidence" Standard

44. I have written my report with the understanding that a party challenging the validity of an issued U.S. patent in litigation bears the burden of proving invalidity by clear and convincing evidence.[3] I understand that establishing invalidity by clear and convincing evidence requires more than a preponderance of the evidence, but less than evidence beyond a reasonable doubt.

1. Invalidity in View of Prior Art

45. In analyzing whether prior art renders a patent claim invalid for obviousness, I understand that a determination must be made regarding what constitutes prior art to a claimed invention. I understand that this is assessed on a claim-by-claim basis, and that a determination of whether a claim is entitled to an earlier effective filing date is required. I understand that Capella, as the patentee, bears the burden of establishing that its claimed invention is entitled to an earlier priority date than an asserted prior art reference. In analyzing whether certain references constitute prior art to the Asserted Claims, I analyzed whether Capella can establish entitlement to an earlier invention date for any of the Asserted Claims and whether the Asserted Claims are entitled to claim priority to the filing dates of certain earlier-filed applications.

[3] I understand that, in many cases, the United States Patent and Trademark Office and the Patent Trial and Appeal Board apply or have applied a "preponderance of the evidence" standard, which is a different evidentiary standard. I understand that the preponderance of the evidence standard is generally not used in district courts to determine whether a patent and/or its claims are invalid. My opinions do not utilize the preponderance of the evidence standard; they instead utilize the clear and convincing evidence standard described above.

a) Entitlement to an Earlier Priority Date Based on an Earlier-Filed Provisional Application

46. I understand that a patent or published patent application may be entitled to an earlier priority date based on an earlier-filed provisional application. It is my understanding that the provisional application at issue must contain, for at least one claim recited in the patent or published patent application, a written description of the invention and the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable a person of ordinary skill in the art to practice the claimed invention. I discuss my understanding of the written description and enablement requirements below.

b) Entitlement to an Earlier Priority or Effective Filing Date Based on Conception and Diligent Reduction to Practice

47. I understand that a patent or published patent application may also be entitled to an earlier priority date based on conception and diligent reduction to practice. It is my understanding that there are several significant dates that are relevant to this analysis. The first is the date of conception. Specifically, conception is not complete until the inventor has formed a definite and permanent idea of the complete and operative invention, as it is to be applied in practice. Conception must include every feature or limitation of the claimed invention and must be corroborated by legally sufficient evidence.

48. A second significant date is that of reduction to practice. I understand that there are two types of reduction to practice. An actual reduction to practice requires that the inventor constructed an embodiment or performed a process that met all the limitations of the claim and determined that the invention would work for its intended purpose. The second type is a constructive reduction to practice that is deemed to occur upon the filing of a patent application.

49. I understand that for a patentee to be entitled to rely upon a conception date as the date of invention for purposes of a prior art analysis, he or she must have been reasonably

diligent from conception through reduction to practice, which I understand is referred to as the "critical period." The patentee must account for the entire critical period. I understand that, while there need not necessarily be evidence of activity on every single day if a satisfactory explanation is evidenced, bald assertions that the inventor has been diligent will not suffice, and an inventor's testimony of his own diligence must be corroborated. The underlying question is whether, on all of the evidence, there was reasonably continuing activity to reduce the invention to practice.

50. It is my understanding that that a "satisfactory explanation" for a period of inactivity during the critical period is otherwise known as an "excuse." Such satisfactory explanations may include poverty or illness of the inventor, duties of employment, and the workload of an attorney assisting in the drafting of a patent application. It is my understanding that the following are generally considered unsatisfactory explanations, and do not constitute a legal excuse: commercial exploitation of an invention, doubts about the value or feasibility of an invention, and work on other inventions.

c) Definition of Prior Art

51. I understand that at least the following sources qualify as prior art under 35 U.S.C. § 102, namely if:

- the claimed invention was known or used by others in the United States, or patented or described in a printed publication in the United States or a foreign country, before the date of the invention (§ 102(a));
- the claimed invention was patented or described in a printed publication in the United States or a foreign country, or in public use or on sale in the United States, more than one year prior to the constructive filing date of the U.S. patent application for the claimed invention (§ 102(b));
- the claimed invention was described in a published patent application or issued patent that was filed in the United States before the date of the invention (§ 102(e));

- the applicant did not invent the subject matter of the claimed invention (§ 102(f)); and/or
- the claimed invention was made in the United States by another inventor, before the invention by the applicant, who had not abandoned, suppressed, or concealed it (§ 102(g)).

52. While these sources of prior art are described with reference to anticipation, I understand that they are sources of prior art for both anticipation and obviousness. In analyzing whether prior art renders a patent claim invalid for obviousness, I understand that a determination must be made regarding what constitutes prior art to a claimed invention. I understand that this is assessed on a claim-by-claim basis, and that a determination of whether a claim is entitled to an earlier effective filing date may be required.

53. My analysis of whether certain references constitute prior art to the Asserted Claims is based on my understanding of the priority and invention dates as identified in Section IX.1 (Paragraphs 170-1774), below. As explained in greater detail below, however, the Asserted Claims are invalid regardless of whether the Asserted Claims are given the invention dates asserted by Capella or whether the Asserted Claims are given a priority date based on their filing dates.

d) Obviousness

54. I understand that, under the doctrine of obviousness, a claimed invention may be invalid if it would have been obvious to one of ordinary skill in the art in view of the prior art teachings of a single reference or a combination of references. I understand that a prior art reference need not be enabled or operable to render a patent claim invalid for obviousness.

55. Under the doctrine of obviousness, a claim may be invalid if the differences between the invention and the prior art are such that the subject matter as a whole would have

been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains.

56. I understand that obviousness is based on (1) the scope and content of the prior art, (2) the differences between the prior art and the claim, (3) the level of ordinary skill in the art, and (4) secondary indicia of obviousness and non-obviousness, to the extent they exist.

57. I understand that secondary indicia of non-obviousness should be considered when evaluating whether a claimed invention would have been obvious to one of ordinary skill at the time of invention. These secondary indicia may include, for example:

- a long-felt but unmet need in the prior art that was satisfied by the claimed invention;
- commercial success of processes covered by the patent as a result of the merits of the claimed invention, rather than the result of design needs, market pressure, advertising, or similar activities;
- unexpected results achieved by the invention;
- praise of the invention by others skilled in the art;
- the taking of licenses under the patent by others;
- whether others had tried and failed to make the invention;
- whether persons of ordinary skill in the art expressed surprise or disbelief regarding the invention;
- whether the inventor proceeded contrary to accepted wisdom;
- independent contemporaneous invention by others; and
- deliberate copying of the invention.

I understand that there must be a relationship, or nexus, between any such secondary indicia and the claimed invention. I understand that no such nexus exists when the alleged secondary consideration is due to an element in the prior art.

58. It is also my understanding that there are additional considerations that may be used as further guidance as to when the above factors will result in a finding that a claim is obvious, including the following:

- the nature of the problem being solved;
- the express, implied, and inherent teachings of the prior art;
- the knowledge of persons of ordinary skill in the art;
- whether the claimed invention is simply a combination of prior art elements according to known methods to yield predictable results;
- whether the claimed invention is a simple substitution of one known element for another to obtain predictable results;
- whether the claimed invention uses known techniques to improve similar devices or methods in the same way;
- whether the claimed invention applies a known technique to a known device or method that is ready for improvement to yield predictable results;
- whether the claimed invention would have been "obvious to try" choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success;
- whether there is known work in one field of endeavor that may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to one of ordinary skill in the art;
- whether there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims; and
- whether there is some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

59. Finally, I understand that a claim may be deemed invalid for obviousness in light of a single prior art reference, without the need to combine references, if the elements of the

claim that are not found in the reference can be supplied by the knowledge or common sense of one of ordinary skill in the relevant art.

2. Invalidity Due to Lack of Written Description

60. I understand that a patent must contain a written description of the claimed invention that is sufficient to convey to one of ordinary skill in the art that the inventor had possession of the claimed invention at the time the inventor filed the patent application. I understand that this is legally referred to as the "written description" requirement.

61. I understand that the written description must actually or inherently disclose each and every element of a claim for that claim to meet the written description requirement, and that it is legally insufficient that undisclosed subject matter would have been obvious to a person of ordinary skill in the art. Moreover, I understand that the written description requirement cannot be satisfied if the specification expresses a mere wish or plan for obtaining the claimed invention.

62. I understand that the specification must provide a written description for the full scope of the claims. I understand that it is unnecessary for a patentee to spell out every detail of the alleged invention in the specification, and that the patentee need include only enough detail to convince a POSITA that the patentee actually possessed the invention. However, I also understand that a patentee cannot always satisfy the written description requirement for expansive claim language by merely, for example, describing one embodiment of the thing claimed. I also understand that a broad claim is invalid when the entirety of the specification clearly indicates that the invention is of much narrower scope.

63. I understand that compliance with the written description requirement is assessed with respect to the application as it was filed, not the patent as issued.

3. Invalidity Due to Lack of Enablement

64. I understand that a patent must contain a disclosure of sufficient information so that a person of ordinary skill in the art can make and use the full scope of the claimed invention without undue experimentation. I understand that this is legally referred to as the "enablement" requirement.

65. I understand that factors to be considered in determining whether undue experimentation is required include the following: (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims.

66. I understand that compliance with the enablement requirement is assessed with respect to the application as it was filed, not the patent as issued.

IV. THE ASSERTED CLAIMS

67. I have been informed by counsel for Defendants that Capella is asserting Claims 23–29, 31–35, 37, 39, and 44–54 of'905 Patent and Claims 68–72, 79–85, 87–92, 96–100, 106, 115–118, 122–127, 129–135, and 137–139 of the '906 Patent. I will collectively reference these claims as "the Asserted Claims" in this report. The text of the Asserted Claims is set forth in Appendix C to this report.

V. CLAIM CONSTRUCTION

68. The Court issued a claim construction order on February 9, 2021. I note that the Court issued the following constructions, and I have applied these constructions in my analysis of the Asserted Claims:

Disputed Term	**Construction**
"ports" • '905 Patent Claims 1, 15, 16, 19, 23, 47, 49, 51 • '906 Patent Claims 61, 115, 133	Plain and ordinary meaning
"fiber collimators . . . providing . . . port(s)" • '906 Patent Claims 1, 21, 31, 37, 44, 68, 89, 100, 115	
"beam-deflecting element(s)" • '905 Patent Claims 23, 47, 49, 51 • '906 Patent Claim 133	Plain and ordinary meaning
"said elements being . . . controllable" • '905 Patent Claims 23, 47, 49	Plain and ordinary meaning
"controlling . . . said beam-deflecting elements" • '905 Patent Claim 51	
"controlling said other beam-deflecting elements" • '905 Patent Claim 52	
"said channel micromirrors being . . . controllable" • '906 Patent Claims 68, 89, 100, 115	
"controlling said beam-deflecting elements" • '906 Patent Claim 133	
"said elements being . . . continuously controllable" • '905 Patent Claims 23, 47, 49	"said elements being . . . controllable such that they can be continuously adjusted"
"controlling . . . continuously said beam-deflecting elements" • '905 Patent Claim 51	"controlling . . . said beam-deflecting elements such that they can be continuously adjusted"

Disputed Term	Construction
"continuously controlling said beam-deflecting elements" • '906 Patent Claim 133	"controlling said beam-deflecting elements such that they can be continuously adjusted"
"said channel micromirrors being . . . continuously controllable" • '906 Patent Claims 68, 100, 115	"said channel micromirrors being . . . controllable such that they can be continuously adjusted"
"said [beam-deflecting] elements being . . . controllable in two dimensions" • '905 Patent Claims 23, 47, 49	"said [beam-deflecting] elements being . . . controllable in two spatial dimensions"
"controlling said beam-deflecting elements in two dimensions" • '905 Patent Claim 51 • '906 Patent Claim 133	"controlling . . . said beam-deflecting elements in two spatial dimensions"
"a control unit for controlling each of said beam-deflecting elements" • '905 Patent Claim 24	Plain and ordinary meaning
"a processing unit responsive to said power levels for controlling said beam-deflecting elements" • '905 Patent Claim 25	Plain and ordinary meaning
"a processing unit responsive to said power levels for providing control of said channel micromirrors" • '906 Patent Claims 70, 90, 117	Plain and ordinary meaning
"a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels" • '905 Patent Claims 44	Plain and ordinary meaning

Disputed Term	Construction
"a servo-control assembly . . . for monitoring power levels of selected ones of selected channels" • '905 Patent Claim 25	Plain and ordinary meaning
"a servo-control assembly . . . for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports" • '906 Patent Claim 69	
"a servo-control assembly . . . for maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports" • '906 Patent Claim 89	
"a servo-control assembly, in communication with said channel micromirror sand said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports" • '906 Patent Claim 116	
"channel micromirrors" • '906 Patent Claims 68, 89, 100, 115	"movable micromirror assigned to a specific channel"
"mirror[s]" • '905 Patent Claim 29	Plain and ordinary meaning
"micromirrors" • '905 Patent Claim 46	
"micromachined mirror[s] • '905 Patent Claim 35	

Disputed Term	**Construction**
"corresponding" • '905 Patent Claims 23, 47, 49, 51 • '906 Patent Claims 68, 89, 100, 115, 133	Plain and ordinary meaning
"said elements being individually . . . controllable" • '905 Patent Claims 23, 47, 49	"each of the elements being controllable separately from the other elements"
"said channel micromirrors being individually . . . controllable" • '906 Patent Claims 68, 115	"each of the micromirrors being controllable separately from the other micromirrors"
"said channel micromirrors being individually controllable" • '906 Patent Claim 89	"each of the channel micromirrors being controllable separately from the other channel micromirrors"
"said channel micromirrors being individually . . . controllable" • ''906 Patent Claim 100	"each of the channel micromirrors being controllable separately from the other channel micromirrors"
"said auxiliary channel micromirrors are individually pivotable" • '906 Patent Claim 127	"each of the auxiliary channel micromirrors being pivotable separately from the other auxiliary channel micromirrors"

In the event the Court modifies these constructions or enters new constructions, I reserve the right to offer modified or new opinions to address those constructions.

VI. THE ASSERTED CLAIMS' ALLEGED PRIORITY DATE AND THE LEVEL OF ORDINARY SKILL IN THE ART

69. It is my understanding that Capella has alleged that the Asserted Claims are entitled to a priority date of March 19, 2001, based on the filing of the Provisional Application. *See, e.g.*, Plaintiff Capella Photonics, Inc.'s Objections and Responses to Defendants' First Set of Interrogatories (Nos. 1-20) at 6–7 (Nov. 9, 2020) (Capella's Response to Interrogatory No. 1).

70. In forming my opinions, I have considered the level of ordinary skill in the art on and around March 19, 2001. In determining the characteristics of a hypothetical POSITA for the Asserted Patents in the relevant timeframes, I considered several things, including my over three decades of experience in the field of optical switching, the sophistication of the technology involved and the educational background and experience of those actively working in the field. I placed myself back in the relevant timeframes and considered the engineers that I had worked with in the field.

71. In my opinion, a POSITA on or around March 19, 2001 would have been an engineer or physicist with at least a Master's degree, or equivalent experience, in optics, physics, electrical engineering, or a related field, including at least three years of additional experience designing, constructing, and/or testing optical systems. Additional industry experience or technical training may offset less formal education, while more advanced degrees or additional formal education may offset lesser levels of industry experience.

72. Based upon my education and experience, I am very familiar with the level of relevant knowledge about the technology at issue that a POSITA would have possessed on or around March 19, 2001. As a result of my education and experience in the industry, I am very familiar with the state of the art of optical switching during that timeframe.

73. Although my qualifications exceed those of a POSITA, both as of March 19, 2001 and today, I have nonetheless applied the perspective of a POSITA in rendering my opinions throughout this report.

VII. TECHNOLOGY BACKGROUND AND STATE OF THE ART

74. Telecommunications has a long and innovative history. Even in the 1880s, Alexander Graham Bell, one of the pioneers of the telephone actually patented an optical communication system that he called the photophone. This was an advancement of his earlier

invention; the telephone. The telephone as we are all aware became the vehicle to drive telecommunications over the last century. While using metallic interconnects for local and trunk communications, the industry was looking for ways to increase bandwidth i.e. send more data in the link. By the 1950s, fiber optics were developed to the point that the planning of fiber optic cable in the 1960s could provide the extra bandwidth needed to carry the ever increasing traffic flow in the telecommunications network. This was driven heavily by AT&T Bell Laboratories in the 1970s. The advancements in fiber optics and how to communicate with photonics technologies has grown consistently to what we see today as we term the 'internet' or the 'network'. The appetite for bandwidth has grown in parallel over the past few decades as more applications have necessitated communications of increased levels of data. One of the metrics that has been used to measure the advancement of fiber optic communication systems has been the submarine fiber optic cables that carry telecommunications traffic underneath the oceans. The best example is the New York to London transatlantic cables where the implementation of fiber optic cables has significantly increased the traffic capacity of newer cables as they have been installed. While this was occurring, in the late 1990s, actually 1997, the first commercial developments of a new technique to increase traffic carrying capacity of a fiber optic cable (or strand) called wavelength division multiplexing (WDM) became available commercially. WDM permits the single fiber optic cable to carry more than one data stream (or channel) by giving each data stream (or channel) a specific and independent wavelength. This is known in the industry as providing data streams with their own colors (as each color represents a different wavelength). So, while the previous fiber optic communication networks could carry a single wavelength or single color in the fiber, the late 1990s and 2000s saw the growth of multiple wavelengths, 10, 40, 80, 160, 320 etc., with each wavelength or color

carrying its own data stream (or channel) traveling through the single fiber. Subsequently, the capacity of the networks increased significantly, and from this point on, fiber optic networks utilize this multiplexing principle for their operation, as can be seen in the network today.

75. One of the major advantages of WDM networking systems that came out of the 2000s is that the data streams do not have to run at the same data rate. This allows a wide degree of flexibility in the design of the optical network. The key for these types of networks is being able to load the different colors of light into the fiber at the entrance or start, and being able to separate the colors from the fiber at the destination of the fiber optic link. In order to do that the individual colors are multiplexed together using multiplexers at the start of the link, and then demultiplexed at the destination of the link. The optical networks that employ this type of WDM technology also employ what is known as add/drop multiplexers. These are optical components that have the facility to add a color or wavelength to the fiber optic cable, or as the name suggests, drop or remove a wavelength from the fiber optic cable. One way of looking at this is similar to an electrical bus you find that carries electrical signals together to reach various parts of say, a computer or a computerized system where there are a number of components or line cards/printed circuit boards. In the add/drop fiber optic system, data or information can be added and dropped as per the network system design.

76. As we have just discussed, optical fiber has been a cost-efficient way to modulate and transmit optical signals over distances, and WDM developed in the late 1990s allowed fiber optic cables to significantly increase bandwidth. These fiber optic links can be point-to-point, and the basic mechanism of operation is common to any of the colors that are carried by the fiber optic cable. For example, a point-to-point fiber optical transmission link typically consists of an optical transmitter and receiver connected over an optical fiber and may use optical

amplification during transmission. The optical transmitter converts electrically modulated data to a modulated optical-carrier signal that is coupled to an optical transmission fiber via a physical link interface. The electrical data can externally modulate a continuous wave (cw) laser drive via an optical data modulator or direct drive the laser. In both instances, interface drive electronics are used to match the data source to the transmission modulation format and requirements for driving the external modulator or laser. Transmitters may also contain other elements like an optical amplifier, an optical filter, an optical isolator, and other components based on the application requirements, data modulation type and data rate.

77. After transmission over the optical fiber, an optical receiver is used to convert the optical data to an electronic analog baseband electrical signal. This electrical signal is amplified, filtered and demodulated. In the case of digital transmission, the final data and clock recovery circuits deliver the original electronic data with as low a bit error as required. A basic receiver consists of a photodetector connected to the fiber that converts the optical signal to a representative modulated electrical current. Depending on the link design and transmission modulation format, there can be an optical filter and/or an optical demodulator prior to photodetection. A series of electronic amplification, filtering and signal processing stages are used to convert the detected signal to an electronic voltage and maintain the signal integrity, reduce distortion, and reject as much noise as possible in order to reproduce the data with as few errors as specified or possible. When more than one color is needed for the link, multiplexers and demultiplexers are utilizes to load a number of colors onto and off of the fiber.

A. Optical Switching

78. One of the challenges in designing an architecture for a dynamic optical network is to provide a vehicle to direct where the optical signals go. Historically, in early telecommunication networks, when updating the routing of optical signals transmitted through

the network, the network would need to convert the signals to electrical signals, electrically switch the signals to different destinations, and then convert the electrical signals back to optical signals, so they could continue onwards towards the destination. While fully optically switched networks are still being developed, a number of the optical network components have been developed to alleviate the electrical switching technology with optical switching architectural solutions. One of these components is the optical switch component. There are a number of designs for an optical switch. Optical switches have the capability of incorporating WDM, or individual colors or wavelengths that can be switched simultaneously. Optical switching systems typically have been described into two main classifications: a) opaque optical switching, in which optical network systems perform regeneration, reshaping of the data signal, and resynchronization of the optical data signals electronically; and b) transparent optical switching, in which optical network systems perform all switching optically. The ratio of transparent to opaque optical switching has been increasing in the transparent side gradually over the past two decades with both types of systems implemented today.

1. <u>Optical Cross-Connects</u>

79. A cross-connect is a component that switches large amounts of traffic or data in one unit. Cross-connects have numerous channels on the input and numerous channels on the output where the data from one channel can be switched to another channel. Cross-connect systems were initially designed as digital cross-connect systems which are electronic based to support the architecture of the growing telecommunications network in the 1970s and 1980s. These digital cross-connects were used to handle the provisioning, protection and restoration of the larger telecommunications network. Once WDM technology was accepted and implemented in the late 1990s, cross-connects were designed to be optical so that they can satisfy the larger capacities of data traffic. The design and size of an optical cross-connect can

scale depending on the design but it must be able to efficiently switch incoming optical signals or colors to any one of the number of outputs. The optical cross-connect will have facilities to both multiplex, and demultiplex the colors from the optical fibers and switch those signals for the correct network connections.

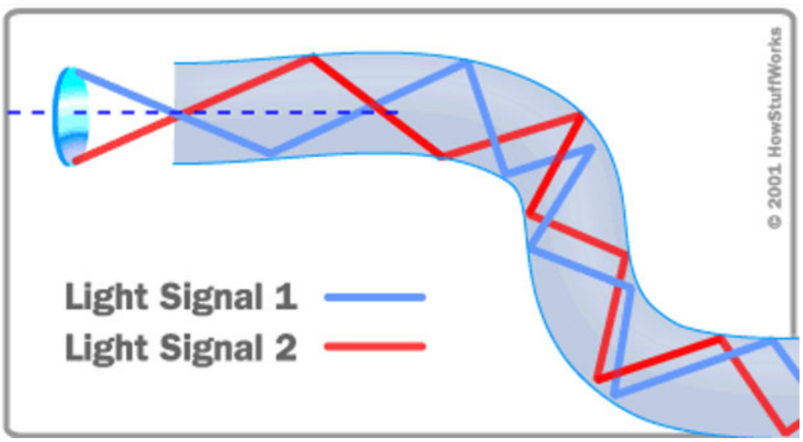
2. <u>Optical Add-Drop Multiplexers (“OADMs”) and Reconfigurable OADMS (“ROADMs”)</u>

80. An Optical add/drop multiplexer is an optical network component that lets specific wavelengths, colors, or channels of a WDM carrying optical fiber that contains multiple channels to be dropped and/or added without affecting the passthrough signals or data flow. There are a number of names that these network components are called such, as a wavelength add/drop multiplexer (“WADM”) or an optical add/drop multiplexer (“OADM”). Over the past two decades, the complexity and design of these network components have increased to become electronically controllable. Controlling the signals that may need to be added or dropped allows the add/drop multiplexer function to become more useful for the network operators. If wavelengths or colors can be added or dropped in a network, then the network becomes more flexible in being able to be provisioned. Provisioning essentially means that some end-users, customers could be provisioned with more capacity for bandwidth than others, and if that can be completely through electronic control, the network becomes more useful economically for the network operator. These types of optical add/drop multiplexers are typically called configurable or reconfigurable optical add/drop multiplexers (“ROADMs”).

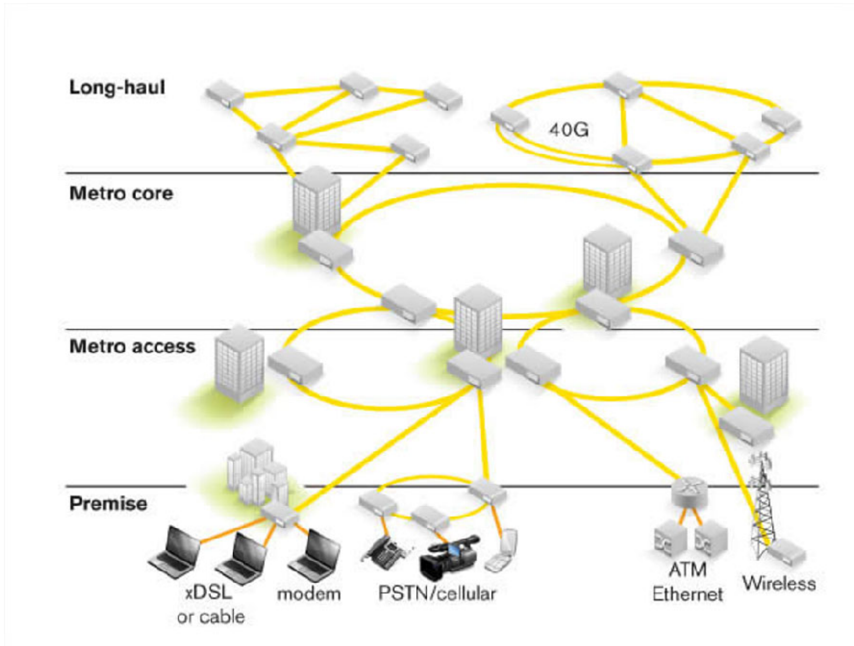
81. Depending on the implementation, a single fiber optic cable can carry many different wavelengths of light, called channels. Typically, systems are designed to carry up to ~100 channels at 100 GHz spacing or up to ~200 channels at 50 GHz spacing. This is referred to a Dense Wavelength Division Multiplexing (“DWDM”). The following image shows an

illustrative example of how two channels travel through a single fiber optic cable using a technique called "internal reflection."

82. Optical networks, and the use of ROADMs in those networks, have grown significantly over the past several years. This growth has required operators of optical networks to add capacity or move to higher capacity systems. In addition, the networks must be adaptable to changing traffic patterns. ROADMs are a critical part of such networks because they allow the network operator to easily reconfigure the traffic patterns.



83. Optical networks are divided into segments as shown in the diagram below, such as long-haul, core, access, and local (premise). Other terms may also be used to describe the segments, such as backbone, regional, and local. At each location where two or more networks meet, called a node, information can be transferred from one network to another, or the information may leave or enter the network. Switches are used to perform these functions.



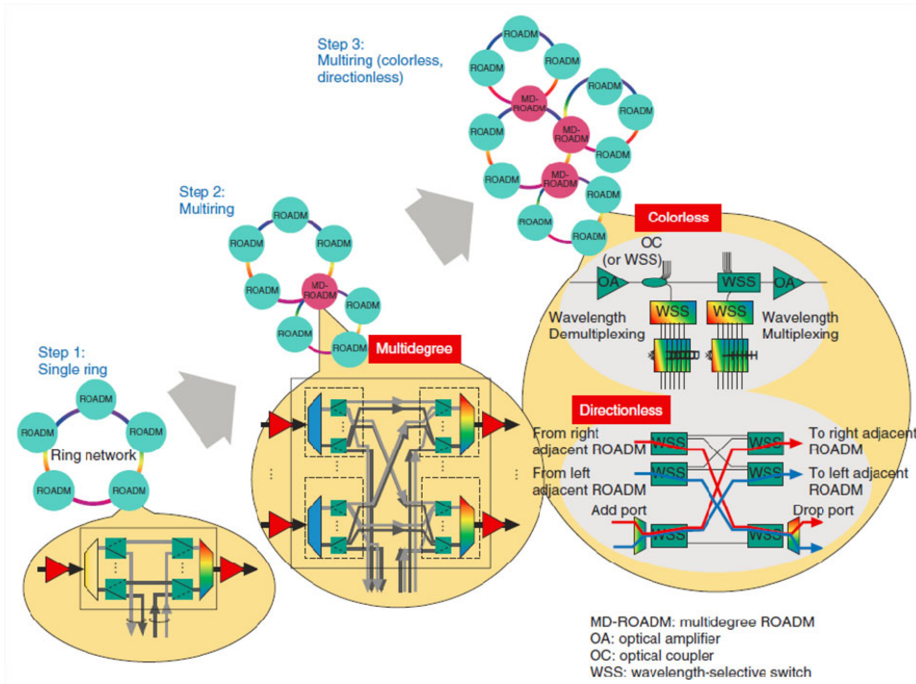
Source: Oculi llc (2012)

84. One of the earliest techniques for switching information at a node was by using Optical-to-electrical-to-optical ("OEO") switches. Those types of switches, however, were expensive, bulky, and are bit-rate/protocol dependent. ROADMs eliminate the need to convert the optical signal into electrical signals. This has advantages for carriers and service providers.

85. Before the introduction of ROADMs, optical switching was done using fixed optical add/drop multipliers, called OADMs. To reconfigure a node with an OADM, technicians needed to install fiber and manually reconfigure the node. A ROADM allows remote reconfirmation of the node. In addition, the ROADM can optimize and equalize power levels at the same time that it switches the optical signals. Using ROADMs makes network planning simpler and more flexible, which lowers cost.

86. A ROADM node consists of multiple ROADMs, each one handling traffic coming from a different direction. These are referred to as "degrees." A 2-degree node will have two ROADMs, while a 4-degree node will have four ROADMs. A node can also be

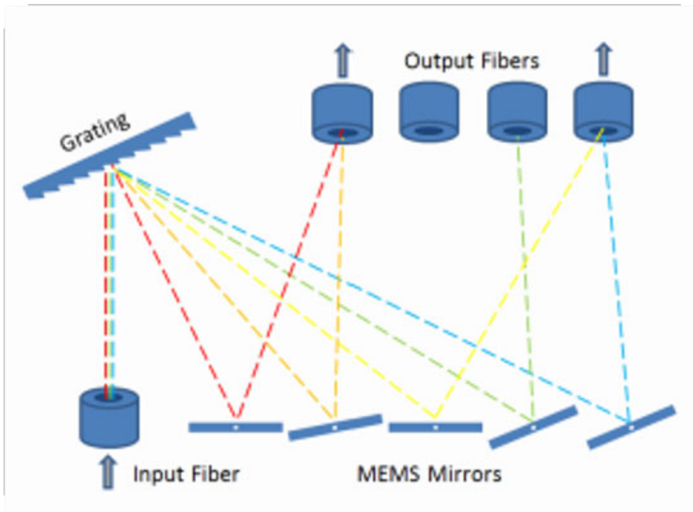
"directionless," meaning that a channel coming from one direction can be switched to any other ROADM in the node. Different types of ROADM nodes are illustrated below



Source: Oculi llc (2012)

3. Wavelength-Selective Switches ("WSSs")

87. At the heart of a ROADM is a Wavelength Selective Switch, or WSS, that can be controlled remotely to change which output ports particular wavelengths are directed to. An example of a WSS using moveable mirrors to control the direction of the light is shown below.



Source: Oculi llc (2012)

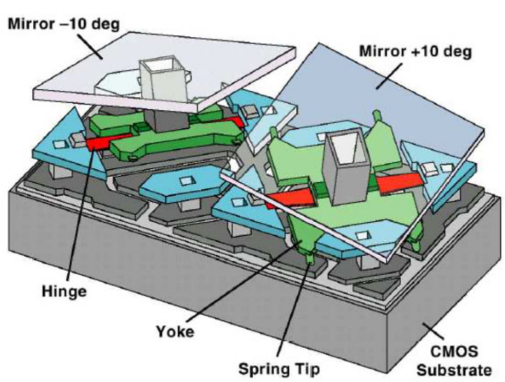
88. Wavelength selective switches are optical components that are utilized in WDM optical networks where their function is to route optical signals or wavelength colors between optical fibers in an optical network. WSSs are an important optical component for implementing optical add/drop multiplexing functionality. The add/drop functionality can be designed to be configurable such as a configurable OADM ("COADM") as well as a reconfigurable OADM ("ROADM"). The typical specifications of an OADM will enable colorless, directionless, contentionless ("CDC") operation while balancing carefully designed features in the optical, electrical, mechanical and control domains. In a typical WSS optical design there are two main sections: a) the wavelength section which separates the input wavelengths and combines the output wavelengths using, for an example, a diffraction grating; and b) a switch section that incorporates an array of ports.

89. There are several different types of WSSs for selectively routing optical signals. One type uses moveable micro-mirrors, referred to as "MEMS" mirrors, to direct channels to different output ports on the WSS. Another type of WSS uses Liquid Crystal on Silicon

("LCoS") to route the communication channels to the different output ports. The switch section of the WSS can vary in design depending on the type of optical switch element is utilized (such as MEMS, LCoS, etc.).

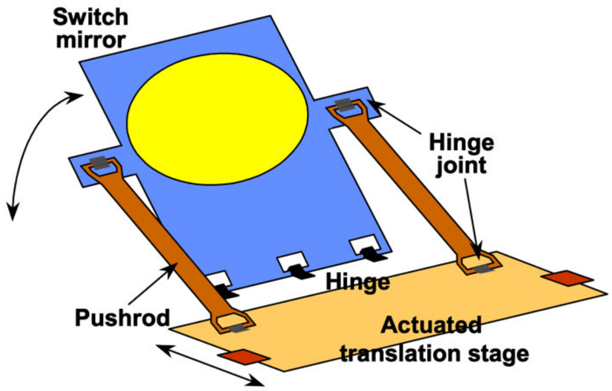
a) Microelectromechanical Mirrors ("MEMs") WSSs

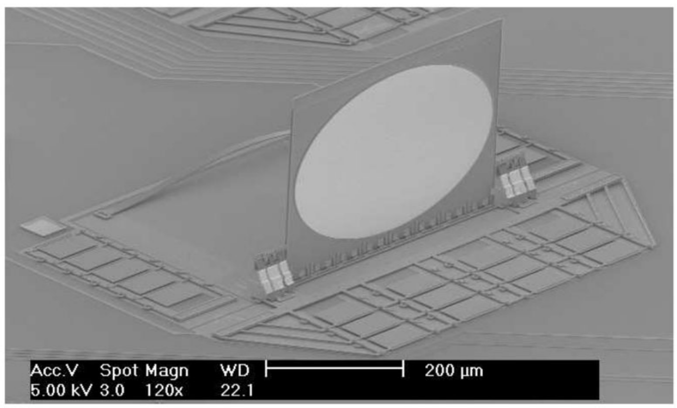
90. WSSs based on MEMS consist of mirrors fabricated in silicon and can be moved using an applied electric field. In the design of the movable mirrors, the angle of movement is a critical specification as can be shown below by a popular digital micromirror device (DMD)[4]. In this case, the MEMS based mirrors can rotate about their axis in the range of +/- 10 degrees. The angle of movement is important in the MEMS device as the larger the movement, the broader the opportunity to point the incoming optical signal to a variety of different destinations. This has driven the MEMS industry to improve designs that can allow the optical beam to be deflected in the range of 90 degrees and thus implementing a right angle for the direction of light.[5]



[4] https://cdn.intechopen.com/pdfs/33598/InTech-Optical_mems.pdf page 299 chapter 3 applications

[5] https://cdn.intechopen.com/pdfs/33598/InTech-Optical_mems.pdf page 317 chapter 3 applications





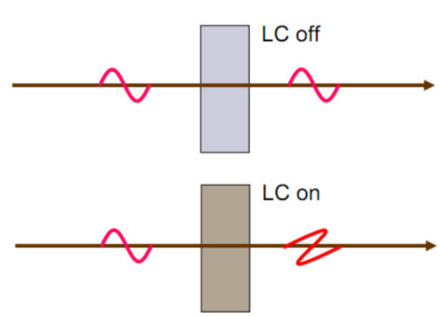
91. As can be seen by the design above, the fabrication of the silicon can allow for innovative designs that can angle the light in a wide range of directions and angular movement. In typical designs, MEMS-based WSSs consist of a front section and a back section. The front section generates an optical signal or beam with a diameter that will suit the size of the mirror. The beam of light that will typically emanate from a fiber optic cable can be expanded using optical lenses so that the beam diameter will match the mirror dimensions so that the mirror surface area is mostly illuminated. The optical lenses are designed to set up the light beam to be confocal. A confocal beam in an optical cavity will have the same focus points, which allows a higher degree of accuracy in alignment. A higher degree of accuracy in alignment simplifies the manufacturing, assembly, and cost structure of a WSS. A common application of a

confocal optical system is a microscope where the light beam is tightly imaged so that the microscopes specimen can be observed with good illumination.

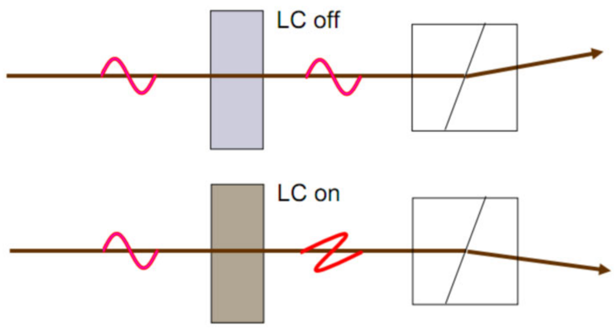
92. A confocal optical system, symmetric on either side of the diffraction grating is generally used for the back end of the system. In typical WSS designs, optical attenuation of the optical signal is completed through the movement of the mirror via optical axes. This is accomplished as the incoming incident light with an original angle of incidence to the surface of the mirror is angled by the mirror pivoting about an axis. Thus, the original angle of incidence is changed, which changes the angle of reflection, and the direction of the light that is reflected off of the mirror. One important advantage of the MEMs optical switch is that the optical beam widths at the mirror are typically less than 10um in diameter. This is important as it allows the switch element to be miniaturized easily.

b) Liquid Crystal ("LC") WSSs

93. In contrast to the MEMS based WSS, a liquid crystal WSS based on liquid crystals have different design criteria. The liquid crystal designs utilize the poling of dipoles in the liquid crystal material to refract and redirect the optical signals. This is a completely different mechanism than MEMS optical switching in that an electrical field is placed across a liquid that turns dipoles in the liquid to align in one direction. This has the effect of opening and closing a shutter for the light.



In the example above[6] the liquid crystal will control the polarization of the incident light by applying an electrical field across the material (LC on). Then to accommodate optical switching, the light as it exits the LC switch is passed through a polarization beam splitter to change the light direction. Therefore, control of the polarization state will angulate the light as required by the design of the optical switch as can be seen below:



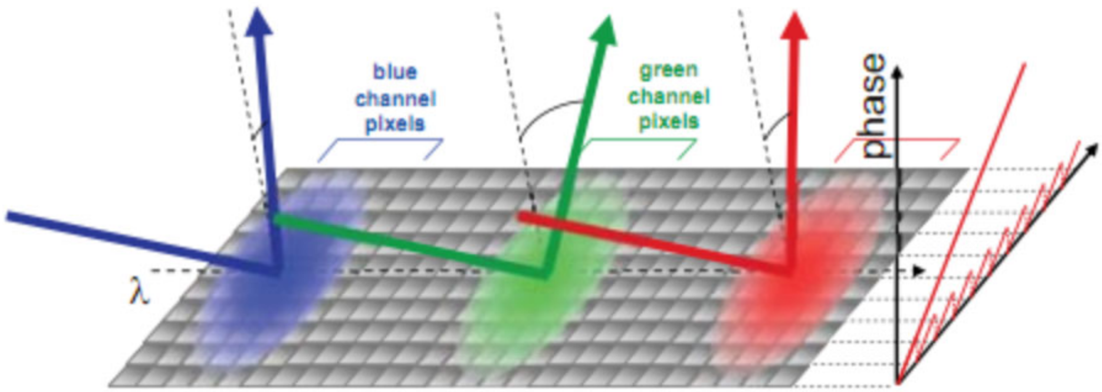
We see this concept utilized in LC displays and LC projectors in everyday consumer electronics. In LC based designs, electronic control of the liquid allows each light channel to be individually tilted. The main difference compared to MEMs is that the LC optical switches are self-contained parts that switch optical beams using fewer mechanical components. Advanced LC optical WSS switches utilize computerized grid formats to accommodate the switching of the light. As the optical channel counts increase, the resolution of LC based optical switches is limited to the resolution of how fine the wavelengths of light can be handled.

c) Liquid Crystal on Silicon ("LCoS") WSSs

94. Improvements in LC designs for smaller beam diameters with higher performance have led to liquid crystal designs to be integrated onto silicon wafers. This technology is called liquid crystal on silicon (LCoS). The smaller reflection surface in LCoS has driven the optical

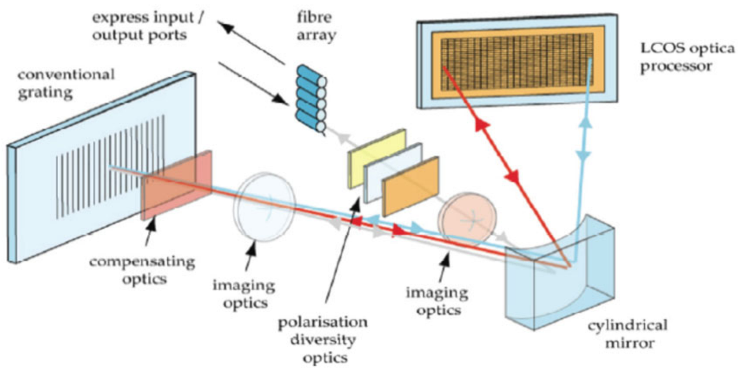
[6] https://www.fiberoptics4sale.com/blogs/archive-posts/95046534-what-is-wavelength-selective-switch-wss

switch engine using LC to be more miniaturized and this has driven its use in fiber optical WSS applications over the past decade. The LCoS optical switch utilizes arrayed pixels that are phase controlled for the beam steering function. This is shown in the figure below:

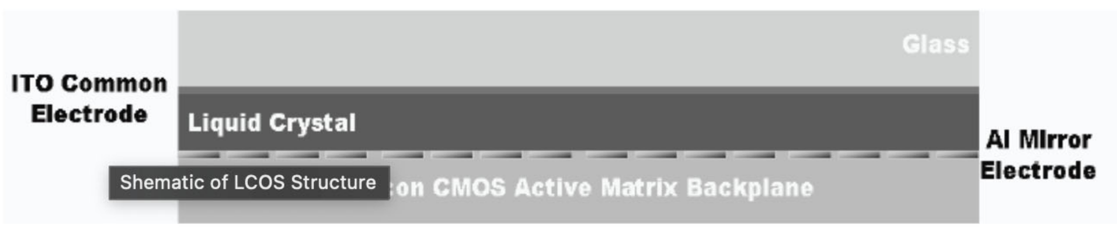


Here, the electrical field that is applied across the LC changes the polarization state. The figure above shows that when the LCoS is implemented into a WSS application, the phase of the light is controlled to produce an electrically-programmable grating laid out in an array format. The beam deflection can now be varied by the blaze (or pitch) of the grating. The channel width is set by the number of pixel columns in the horizontal direction. This size is in the order of 10-20um. In operation, the light passes from a fiber array through the polarization diversity optics which both separates and aligns the orthogonal polarization states to be in the high efficiency s-polarization state of the diffraction grating. The light from the input fiber is reflected from the imaging mirror and then angularly dispersed by the grating, reflecting the light back to the cylindrical mirror which directs each optical frequency (wavelength) to a different portion of the LCoS. The path for each wavelength is then retraced upon reflection from the LCoS, with the beam-steering image applied on the LCoS directing the light to a particular port of the fiber array. In a generic LCoS WSS design as shown below, the light enters from fiber array ports and

is reflected from the mirror, angled by the grating, where the light is reflected back to the mirror, which directs each optical signal to a different portion of the LCoS. The light is then directed to particular port of the fiber array for output.



As can be seen from the cross section of the LCoS technology below, the composition is quite different from a MEMs optical switch.



The substrate is composed of silicon semiconductor material which can include CMOS based electronic circuitry. The liquid crystal is deposited onto the silicon wafer and where both transparent ITO (Indium Tin Oxide) and aluminum conductive contacts are used to apply the electrical field across the liquid crystal material for dipole alignment. Glass is used to protect the liquid crystal material and allow optical signals to pass through.

B. Commonly-Used Components for Optical Switching

95. Commonly used components that have been commercially available since the 1970s and 1980s for optical switching. These components are well known with POSITAs who

have electrical/optical, and physics-based engineering degrees that practice fiber optical communications. There are many text books in the public domain that detail operation of commonly-used components for optical switching that are available before 2001. Optical components[7] that have been designed for optical switching have evolved since the 1980s.[8] with applications such as optical computing enabled innovation in the subject.[9] The development of optical components for fiber optic communications has evolved significantly over the past 3-4 decades. A good example is the text book by Palais published in 1988 that has been popular in undergraduate courses.[10] Many of the optical components utilized in optical switching are detailed in the 3rd edition of optical fiber telecommunications text books (IIIA and IIIB) published in 1997.[11] This text book reviews a number of optical components that include for example; laser diodes, photodetectors, diffraction gratings, wave plates, fiber collimators, prisms, correction lenses, fiber optic strands, fiber connectors, optical package platforms (such as gold boxes), etc.

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[7] Text book: Optical Fiber Telecommunications II; Chapter 11 for example for optical switching, Chapters 9 and 10 for Integrated optics and optical components.

[8] Text book: Optical switching and networking handbook (2001)

https://drive.google.com/file/d/1dqmLTboWMpKK0LEobmiZeXSD82daaH7u/view?usp=sharing

[9] Text book: Optical computing, Authored by D.G. Feitelson, Published by MIT press, 1988

[10] Text book: Fiber Optic Communications 2nd Edition; Author J Palais, published by Prentice Hall (1988).

[11] Text books: Optical Fiber Telecommunications (Volume IIIA and IIIB), edited by Kaminow and Koch, published by Academic Press (1997).
1) Optical fiber telecommuncations IIIB (1997)

https://drive.google.com/file/d/1138FHPbxbEgo6y73HNYluj_w5pHv5srb/view?usp=sharing

2) Optical fiber telecommunications IIIA (1997)

https://drive.google.com/file/d/16SuewRfNO8lIVXGye3HRV3etD5pSiS18/view?usp=sharing

1. Optical Fibers

96. Optical fibers are thin silica glass-based cables or strands that are composed of a core region and a cladding region and were first commercially implemented in the 1970s by companies such as Corning, NTT, AT&T etc. They are reported in detail in Miller and Chynoweth's text book published in 1979.[12] The core region of a fiber optic strand is typically in the region of about 5-10um in diameter, and the cladding region that surrounds the core region typically is in the region of about 120-150um in diameter depending on design. The core region has an optical refractive index slightly higher than the cladding region to promote internal reflection. The internal reflection property allows the optical wave or signal to traverse the core region of the optical fiber. Over the past few decades, the performance of the optical fiber cable has improved to the extent that optical signals can be sent through atomically clear silica glass for many hundreds of kilometers. There has been significant technology advancement to permit optical signals to traverse the optical fiber cable or stand both in quality of the data signal to be recognized and interpreted correctly at the destination for high quality information transfer.

2. Collimating Lenses

97. Collimating lenses are optical lenses that are designed to collimate the input optical signal to a collimating beam on the output and have been commercially available since the 1980s. The lenses are designed to be both compact for application in telecommunication environments to work with fiber optics and can be found in both discrete, individual forms as well as arrays (to match arrays of fibers). The materials for collimating lenses can vary from

[12] Text book: Optical Fiber Telecommunications, edited by Miller and Chynoweth, published by Academic Press (1979).

glass to semiconductor to organic material depending on application and specification. Lenses can be molded as well as fabricated with standard semiconductor processing techniques.

3. Circulators

98. Circulators are popular optical components in the network and have been commercially available since the 1990s. Circulators are typically three or four port optical devices or components in a way that an input optical signal or data stream entering any port will exit at the next port, similar in a way to motor vehicle round-abouts or traffic circles. For example, if the input optical signal or data stream enters the first port, it will leave the circulator at the second port, but if some of the optical signal is reflected back to the circulator, the optical signal will exit at the next port or the third port. Optical circulators based on fiber optics are used to distinguish optical signals from each other that would be in opposite direction to each other. Circulators have the properties of high isolation of the input optical signals and a high level of reflected optical powers. Furthermore, circulators have excellent properties of low insertion loss and are widely used in WDM network architectures.

4. Ports

99. Ports are points or terminals on an optical component or device that allow entry of an optical signal or data stream. Ports as the name suggests, can also act as exit points or terminals for an optical signal or data stream and have been a common part of optical system design since the 1980s. While ports are not limited to optical components or devices, they represent entry and exit of optical signals or data streams. Specific types of ports include, but are not limited to, circulator ports and fiber collimator ports. Other optical ports that are utilized can come in the form of fiber connectors, both single, as well as arrayed and ribbon varieties. Ports can be designed to allow the light to pass through free space as well as butt-jointed i.e. having the fiber physically joined to the optical component.

a) Circulator Ports

100. Circulator ports are those ports that allow for entry or exit of optical signals or data stream as part of a circulator component or device. Optical signals can be in the form of optical fiber strands, free space, optical waveguides and any other technique to allow for entry of an optical signal into and out of a port.

b) Fiber Collimator Ports

101. Fiber collimator ports are those ports that are embedded within or packaged together with a fiber collimator component or device. Fiber collimators as the name suggests are optical components or devices that collimate the input optical signals or optical data stream into a collimated beam at the output.

5. Mirrors

102. Mirrors are optical components or devices that have optical properties of reflecting the incident or entry optical beam and have been utilized in commercial optical systems since the 1970s. Similar in operation as a home, bathroom mirror, mirrors will reflect the incident optical beam back towards the origin. Mirrors are optimized in their design for reflection with constructive interference as opposed to anti-reflection where incident optical signals are destructively interfered. Mirrors for optical communications and optical networking are designed to reflect optical wavelengths that typically are in the infra-red part of the electro-magnetic spectrum.

a) Pivotable Mirrors

103. Pivotable mirrors are mirrors with the capability to physically move and MEMS technology has been commercially available since the 1980s and 1990s. MEMS technology platforms generally have physically movable mirrors that can be electronically controlled. These mirrors can be anchored and provide a pivoting motion in one or two dimensions or axes.

(i) *Mirrors Pivotable About One Axis*

104. Mirrors that are pivotable about one axis is as the term suggests, physically movable in one axis only. This axis could be for example the x-axis or it could be the y-axis. Mirrors pivotable about one axis could be represented by the action of a motor vehicle draw-bridge that opens in the center and has two sides. In this example, the vehicle roadway is pivoted from one of the sides in an upward and downward motion. Tower Bridge of London England is an excellent example of a something that is pivotable about one axis.

(ii) *Mirrors Pivotable About Two Axes*

105. Mirrors that are pivotable about two axes is as the term suggests physically movable in two axes only. These axes could be for example in both the x-axis and the y-axis. Upward, downward (North and South), would be one movement, while side to side (East and West) would be another movement. In this case the two axes movement would be pivoted through a single anchor.

b) Channel Micromirrors

106. A channel micromirror is a moveable mirror assigned to a specific spectral channel, with the function of reflecting one channel or one wavelength color.

c) Silicon Micromachined Mirrors

107. Silicon micromachined mirrors are mirrors that are part of the MEMS technology platform. The miniature structures are etched from silicon wafers and are referred to as "micromachined." MEMs devices can be designed and fabricated in a number of semiconductor materials, where a significant amount of the bill of materials of the MEMs device is silicon-based. MEMs devices like the majority of all optical components requires packaging for environmental protection, connections to the outside world, and optical coupling, is dependent on how the packaging is designed. Gold box, hermetic packaging is expensive and is a

significant part of the MEMs packaged bill of materials, while higher volume plastic based, molded packaging is more cost effective, and can be similar in cost structure as the MEMs device itself.

d) Alignment Mirrors

108. The function of alignment mirrors is as the name suggests, mirrors with the intent to align the optical signal, signals in various forms. The optical signals could be in the form of diverging, converging, or even collimating beams of light. As optical signals need to be aligned so that light is coupled (or connected) correctly, alignment processes are needed in a system. These mirrors can be planar, convex, concave or consisting of multiple optical functionality.

6. Wavelength-Selective Devices

109. Wavelength selective devices are such devices that can deal with specific wavelengths of the optical signal, or light beam and have been commercially available since the 1980s. A popular vehicle for WSDs is the diffraction grating. In general, a diffraction grating is an optical component with a periodic structure that splits and diffract the optical signal or light beam into several light beams travelling in different directions. These optical components are used to separate the optical signal or light beam into its component wavelengths or colors. They are commonly used in fiber optic components for optical switching, spectroscopy, or for integration into spectrophotometers or monochromators. Normal designs of diffraction gratings consist of a series of closely packed grooves that have been formed into the grating's surface. Popular diffraction gratings can be either transmissive or reflective. As light transmits through or reflects off a grating, the grooves cause the optical signal or light beam to diffract, dispersing the light into its component wavelengths or colors. In general, diffraction gratings are sensitive devices and require careful handling as they utilize soft coatings and require specific cleaning techniques.

a) Ruled Diffraction Gratings

110. A ruled grating typically consists of a series of grooves that have been cut, etched, engraved, formed etc., into a surface of a grating. Typical examples of a groove can be from tools such as a diamond, photolithography etching in fabrication, holographic imaging then etching, electron-beam lithography followed by etching etc. Ruled gratings are normally found in optical systems that require high efficiency.

b) Holographic Diffraction Gratings

111. A holographic diffraction grating is produced using interference lithography which results in a smooth groove surface and eliminates the periodic errors found in ruled gratings. Holographic gratings are another form of diffraction grating that are ideal for applications that require minimal stray light. They are typically fabricated using an interference fringe field of two laser beams of light and have been commercially available since the 1990s.

c) Echelle Gratings

112. An echelle grating (from French word *échelle*, which can be translated to be a type of ladder) is a type of diffraction grating. The grooves of the diffraction grating are optimized for use at high incidence angles and high diffraction orders. The echelle grating typically consists of a number of slits with widths close to the wavelength of the diffracted light. The light of a single wavelength in a standard grating at normal incidence is diffracted to the central zero order and successive higher orders at specific angles, defined by the grating density/wavelength ratio and the selected order. The angular spacing between higher orders monotonically decreases and higher orders can be very close to each other, while lower ones can be separated apart more. The intensity of the diffraction pattern can be altered by tilting the grating.

d) Curved Diffraction Gratings

113. The main advantage of a concave grating is that it can be used as the primary dispersive and focusing element in various spectroscopic based instruments as well as optical switching systems. The curved diffraction reduces the number of optical elements required, increasing throughput and instrument efficiency. The main advantage of a curved diffraction grating in general is that both the input acceptance angle and the fractional bandwidth can be increased significantly. For example, a concave grating has the advantage of setting up a spectroscopic system without any imaging optics like concave mirrors. For this reason, the concave grating is used in a wide range of applications such as optical communications and optical switching over and above analytical, medical instruments and biotechnology.

e) Dispersing Prisms

114. Dispersive prisms are optical components that usually have the physical shape of a geometrical triangular prism. These components are typically utilized in spectroscopic based instrumentation as well as optical communications and optical switching. The main function and property of a dispersive prism over and above the physical optical design is the dispersion of the optical signal spectrally. The common physical shape of the triangle will allow the input optical signal to be split into spectral components, i.e. optical wavelengths or colors.

7. Beam Focusers

115. Beam focusers are small optical components utilized in the fiber optics industry for fiber communications that focus or converge the optical signal or light beam. In a typical optical system where an input optical signal is collimated i.e. this beam will be wider than the emitter, the focuser will add another lens to the optical system that typically reverses the collimation of the optical signal or light beam and reduces that beam to a spot of light. The

material utilized to fabricate beam focusers can be glass-based, or constructed from molded organic materials for cost economics.

a) Focusing Lenses

116. Focusing lenses are small optical components utilized in the fiber optics industry for fiber communications that focus or converge the optical signal or light beam into a point. The point can be called an image point, principle point, or focal point. These optical components are found in a myriad of designs, physical shapes, and specifications. They can be manufactured out of traditional glass-based materials as well as organic based plastics.

b) Focusing Mirrors

117. Focusing mirrors are small optical components utilized in the fiber optics industry for fiber communications that are characterized by a concave surface that is coated with a highly reflective coating. The reflective coating allows the focusing of an optical signal or light beam. Focus mirrors are typically coated with common metal with high reflection coefficients such as gold, silver, or aluminum as examples.

C. Commonly Used Spatial Arrangements of Components

118. The following are an overview of commonly used spatially arranged components that would be found in optical switching components as part of a fiber optic communications network. These types of components have been available commercially since the 1980s and 90s.

1. Positioning Generally

119. In general, if an optical component is going to be utilized to manipulate and or redirect light, then that optical component needs to be positioned to receive the light typically from a fiber cable port in the first place. The position of the component needs to be optimized so that the optical coupling loss is minimized i.e. the light being coupled from the fiber cable

port to the optical component. While optical coupling is only one metric for an optical system to be aligned together, it does require each of the optical components to be positioned correctly to accept the incoming optical signal in good alignment so that the optical component can undertake its task of manipulating the optical signal before allowing that optical signal to traverse to the next optical component. In normal optical switch designs, the position of optical components is completed using computer controlled pick-and-place robotic systems for accuracy.

2. Focal Points

120. Focal points are those optical points or spot that is formed where the converging optical signal or light beam converges. Focal points are also those optical points or spots from where diverging optical signals or light beams appear to proceed.

3. Arrays

121. Arrays in the context of fiber optic optical switches can be found in a number of components utilized for optical communications. Popular components could be arrays of lenses, arrays of fibers, arrays or lasers, arrays of mirrors. Typically, the term is used to denote a plurality of components either positioned in one axis as a row or column, or two axes in a two-dimensional format.

a) One-Dimensional Arrays

122. One-dimensional arrays are small optical components utilized in the fiber optics industry for fiber communications that are characterized though a layout in one dimension. For optical fibers, this could be a lateral row of fibers positioned in one plane. For optical lenses, this could be a row of optical lenses also in one plane.

b) Two-Dimensional Arrays

123. Two-dimensional arrays are small optical components utilized in the fiber optics industry for fiber communications that are characterized though a layout in two dimensions. For optical fibers, this could be a plurality of rows of fibers positioned in two planes. For optical lenses, this could be a plurality of rows of optical lenses in two planes.

4. <u>WSSs Placed in Series</u>

124. While the functionality of a WSS is well known , each WSS can be designed to specific specifications, physical dimensions, and operability. WSSs can be architected not only as individual optical components, but in different layouts (such as in series or in parallel) depending on the overall system architecture design.

D. Commonly Used Control Principles

125. Control principles are an important element of an optical switch in an optical communications system. Controlling parameters and operation are essentially the engine that makes sure the system is working correctly. There are various forms and architectures for control that can be utilized in an optical switching environment.

1. <u>Control Generally</u>

126. Control generally can be applied for manual or automatic adjustment of a particular level in a system. Control is said to be sequential when the instructions are fed to an electronic process in order during an operation. Control is said to be dynamic when the instructions are varied or altered in sequence during or as a result of an operation.

a) Digital and Analog Control

127. In general, the rise of digital control over the past few decades is because digital controllers are capable of monitoring a number of parameters that can prove too costly to be measured by analog controllers. This means that changing analog to digital controllers may

allow the system being controlled to monitor process functions more precisely. Depending on the requirements of the optical switch architecture, a digital control system can take the form of computerized chip or a full-blown digital computer system. A digital computer system has a level of finite precision which means that attention is needed to ensure the error in parameters such as analog to digital conversion, digital to analog conversion etc., are not producing undesired or unplanned effects.

128. Analog control in general does not have digitalization and consists of the actual analog signals be they electrical, optical to control the system.

b) Continuous and Step-Wise Control

129. Continuous and step-wise control are two different techniques to apply control to a system. With continuous, this can be viewed as the control having infinite values with each value differing from the next and/or the last by an arbitrary small amount. With step-wise control, this is a technique to apply control to a system with discrete and step-like amounts differing from the next and/or the last.

c) Individual and Group Control

130. Individual and group control are two different techniques to apply control to a system. These techniques are utilized for optical switch systems utilized in the fiber optics industry for fiber communications. Individual control is as the name suggest, control using an individual system or individual component technique. Group control is where there is more than one individual component as part of an optical system. Group control depending on the architecture of the optical system can apply to a collection of components, parts, and elements that may make up an optical system.

2. Spectral Monitors and Power-Management Systems

131. Optical spectral monitors and power management systems are important design features for the architecture of optical systems. They are implemented in optical system such as optical switches in optical communication network architectures.

a) Spectral Monitors

132. An optical spectrum analyzer uses reflective or refractive techniques to separate out the wavelengths or colors of the optical signal or light beam.

b) Power-Management Systems

133. Power management systems are electronically architectured systems to monitor and control the power being dissipated in an optical system. Power management systems include features such as design, including power budget planning and overall network signal power monitoring and control strategies. Power management systems typically constitutes an important design consideration in the overall implementation of optical networking architectures.

(i) *Power Control via Angular Misalignment*

134. Power control via angular misalignment is an important feature for optical systems that are architected for optical switching. Angular misalignment can be controlled, corrected, and optimized using computerized power control techniques.

(ii) *Power Control via Lateral or Transitional Misalignment*

135. Power control via lateral or transitional misalignment is an important feature for optical systems that are architected for optical switching. Lateral or transitional misalignment can be controlled, corrected, and optimized using computerized power control techniques.

3. Servo-Control

136. Servo control is a technique that is accomplished by the use of a pulse-width-modulation (PWM) signal from a servo. The PWM is set up such that in a stream of pulses, the width of the pulses are varied depending on how the control should be implemented. In applications such as optical switching for optical communications, the servo-control will control accurately the alignment of the optics for the optical switch and is typically driven by electronic processing technology.

a) Coupling

137. The coupling in an optical system generally refers to optical coupling. It is important that when the optical signal passes from one component or element in a system to another component or element in that system, that the optical coupling is optimized or maximized as desired. This is completed so that the optical light loss between optical components and elements is minimized. Generally, it is easy to lose light and hence optical signal, and when this happens, the integrity of the optical system can be strained and subject to not interpreting the signals correctly. An optical system that does not interpret the optical signals correct is said to have errors, and these errors are important metrics in the system design.

b) Coupling Efficiencies

138. The optical coupling efficiency is a measure of the quality of the optical coupling in an optical system. An optical system may still operate with low efficiency, however, this is a metric of how much optical signal is being transferred from an input to an output of discrete optical components or elements as well as a plurality of optical components or elements.

VIII. OVERVIEW OF THE ASSERTED PATENTS

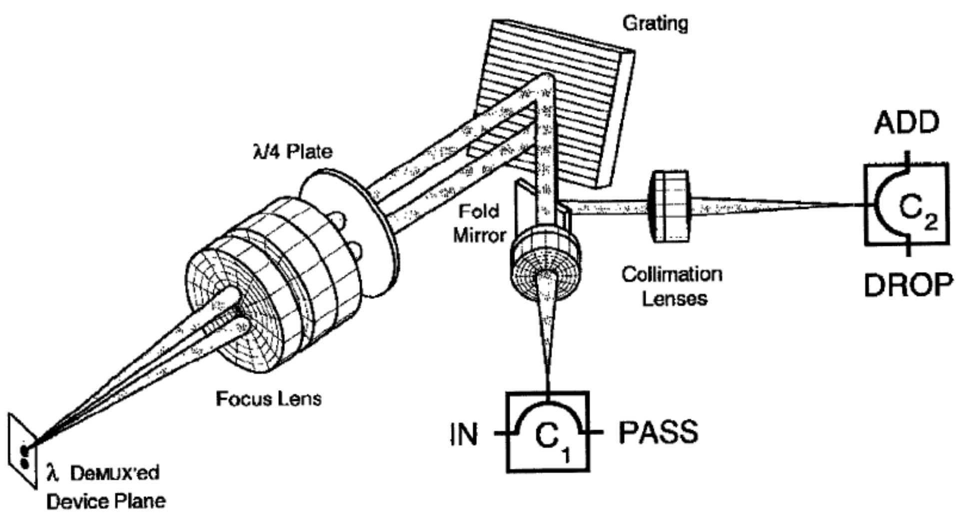
A. The Specification and Claims

139. I have reviewed the specification and the claims of the Asserted Patents. The Asserted Patents share a common specification and claim priority through a chain of patent applications back to the Provisional Application (which, as noted above, was filed on March 19, 2001), which I have also reviewed. The '906 Patent explicitly incorporates the Provisional Application by reference. *See* '906 Patent at 1:31–36.

1. <u>The Provisional Application</u>

140. The Provisional Application describes various components, devices, and principles that existed in the prior art. For example, the Provisional Application provides as Figure 6 a diagram from Joseph E. Ford et al., 17 J. LIGHTWAVE TECH., pp. 904–11 (1999):

Dynamic OADM Architecture (Prior Art)



Ref: J. Ford *et al.*, JLT **17**, pp. 904-911 (1999)

Figure 6 Capella Proprietary & Confidential

This figure shows various optical devices and principles known in the prior art, including (1) coupling lenses/circulators, (2) collimating lenses, (3) mirrors, (4) diffraction gratings,

(5) quarter-wave plates, and (6) focusing lenses. The Provisional Application also discusses that this prior art publication used "[a] binary micromachined mirror array" in which "[e]ach mirror . . . either retroreflects its corresponding channel back along the original input path toward the pass-through port, or it reflects its channel to the drop port":

> Figure 6 shows a graphic of the optical system configuration of the OADM device described in Ref. 1. Two coupling lenses are implemented to convert the light paths from these two fibers to free space. Wavelength separation and routing are done in free space. The device utilizes a ruled diffraction grating to separate the input light into its constituent channels. A binary micromachined mirror array redirects each of the individual channels to one of two outputs. Each mirror in the linear array either retroreflects its corresponding channel back along the original input path towards the pass-through port, or it reflects its channel to the drop port.

Provisional Application at 2. As another example, the Provisional Application provides what it describes as "a block diagram of this device" (*id.* at 2) apparently referring to the device described in the article authored by Joseph E. Ford et al.:

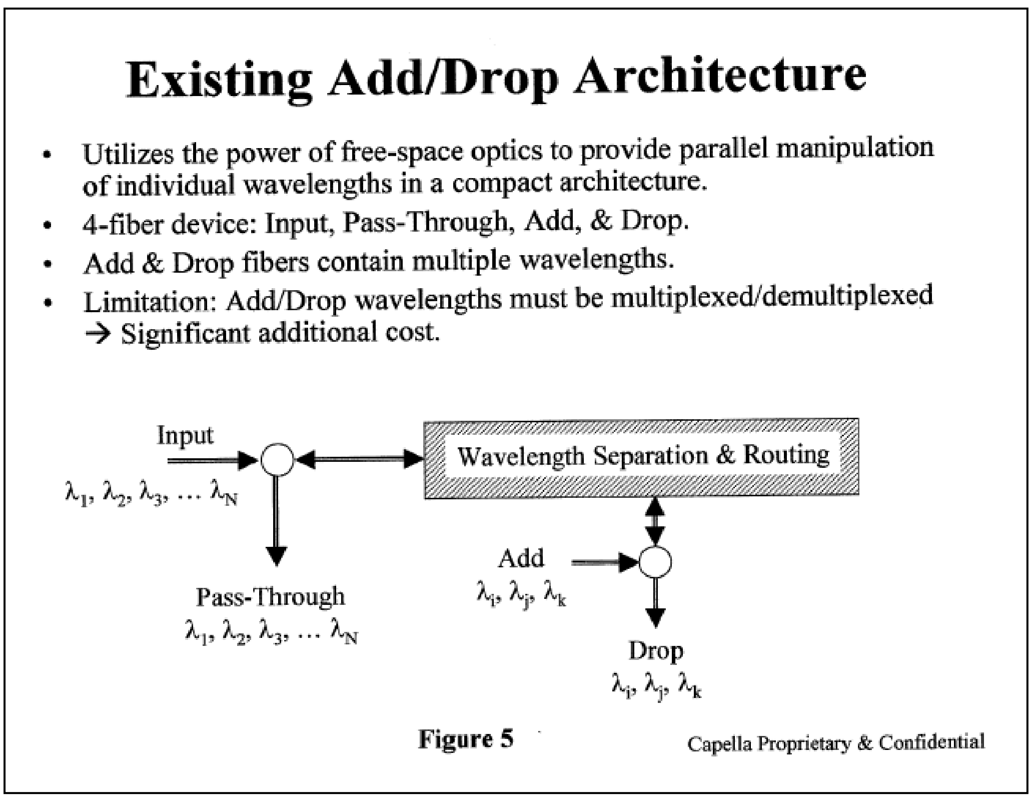


Figure 5

The Provisional Application described Figure 5 as follows:

> A parallel architecture based on free-space optics has been previously described in Ref. 1. A block diagram of this device is shown in Figure 5. It has four fiber ports: (1) input, (2) pass-through, (3) add, and (4) drop. One circulator is used to combine the input and pass- through ports onto one fiber, and another circulator combines the add and drop ports to a second fiber.

Id. at 2.

141. Figure 10 of the Provisional Application showed what it described as "[o]ne embodiment of the present invention" (Provisional Application at 3):

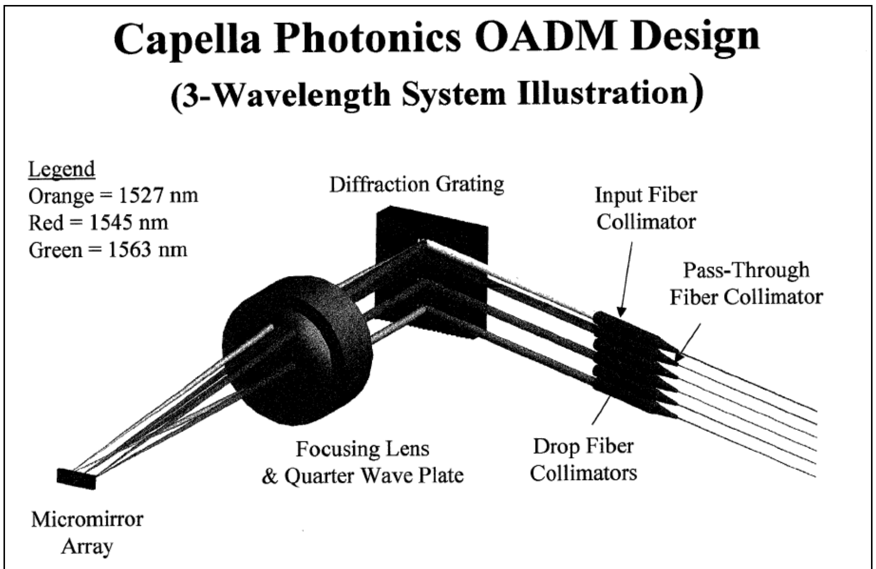


Figure 10

Id., Fig. 10. The Provisional Application explained that "[t]he input/output consists of a linear array of fiber collimators[,] and that "[s]uch collimators [we]re well known in the art:

> One embodiment of the present invention is shown in Figure 10. The input/output consists of a linear array of fiber collimators. Such collimators are well known in the art and are comprised of a collimating lens and ferrule-mounted fiber packaged together in a mechanically rigid stainless steel or glass tube (e.g., see collimators made by ADC Photonics, Inc., Minneapolis, MN, www.adc.com). The collimators can be positioned in a linear array by, for example, means of a V-groove array made out of any of a variety of materials including silicon, plastic, or ceramic. The top collimator is designated the input, the second collimator is

> designated the pass-through, and the remaining collimators are designated as drop ports.

Id. at 3. The Provisional Application also explained that (1) "[e]ach wavelength channel is associated with a single mirror in the micromirror array[,]" (2) "[e]ach of the mirrors . . . reflects its associated wavelength channel . . . back towards one of the output ports." *Id.* at 4. "This require[d] the micromirrors to be dynamically adjustable with at least one axis of rotation." *Id.* "The rotational motion should be under analog control, so that the angles can be continuous [sic] adjusted to scan across all possible output collimator ports." *Id.* The Provisional Application further explained that, "[b]y controlling the angle of each micromirror, the system has the ability to direct each wavelength channel to any of the outputs (pass-through or drop)." *Id.*

142. The Provisional Application acknowledged that "[v]arious types of micromachined mirrors and deflectors exist in the art." *Id.* The Provisional Application noted the existence of "an array of reflective ribbons, the position of each ribbon being under electrostatic control." *Id.* The Provisional Application explained that "[a]n adaptation of such a ribbon array can be used in the present invention to provide the micromirror function, with each ribbon in the array acting as a separately controllable mirror." *Id.*

143. The Provisional Application further explained that, "to provide more control over the coupling efficiency back into a collimator, . . . it is advantageous to have control over the two incoming angles (θx and θy) into the collimator[]" (*id.* at 5). The Provisional Application explained that this could be accomplished using a "dynamic mirror capable of rotation about two orthogonal axes." *Id.* The Provisional Application stated that "[t]he 2-axis dynamic mirror can take the form of a double-gimbaled torsional mirror." *Id.* The Provisional Application then acknowledged that both single-axis and two-axis torsional mirrors existed in the prior art:

> The 2-axis dynamic mirror can take the form of a double-gimbaled torsional mirror. A single-axis torsional mirror is described in Ref. 2, while a two-axis version of such a torsional mirror is described in Ref. 3, and a version developed by Lucent Technologies is shown in Figure 17.

Reference two is identified an IEEE article authored by K.E. Petersen published in 1982. *See id.* at 6. Reference three is U.S. Patent No. 5,629,790 to Neukermans et al., which was filed in October 1993. *See id.* Figure 17 of the Provisional Application, which shows the two two-axis dynamic micromirror developed by Lucent Technologies, reproduced below:

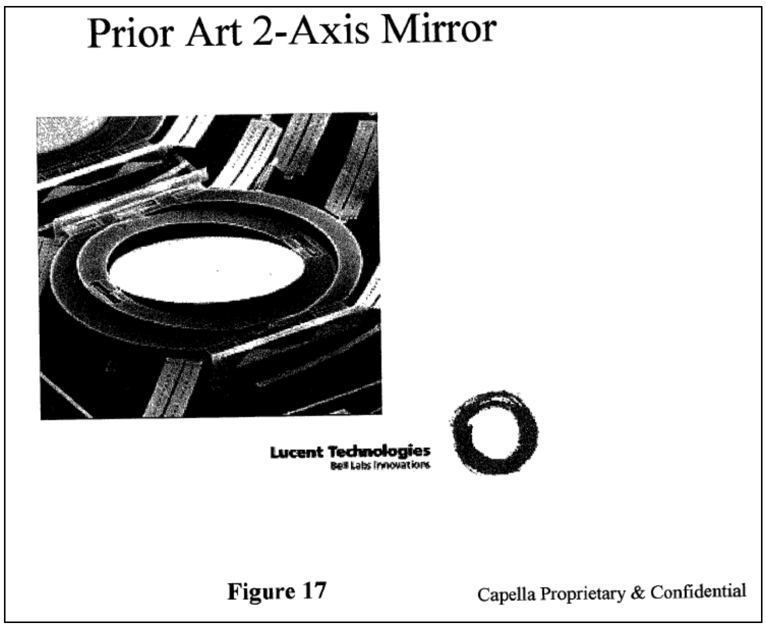


Figure 17

Id., Fig. 17. Figure 16 of the Provisional Application (reproduced below) shows "[o]ne method of achieving such control":

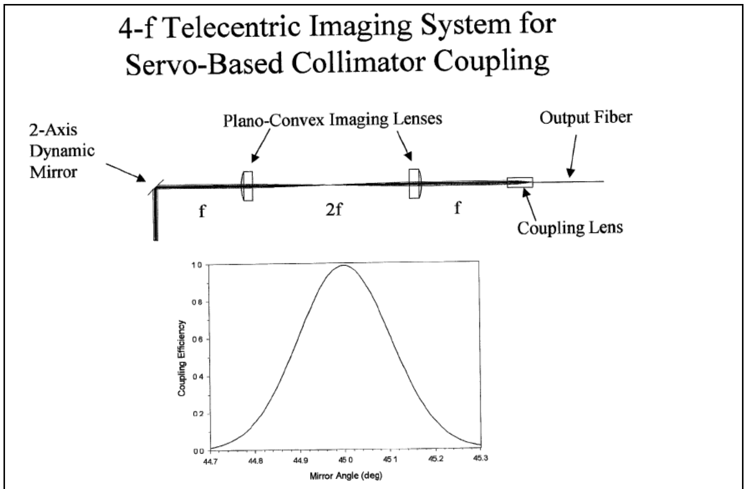


Figure 16 Capella Proprietary & Confidential

Id., Fig. 16. The Provisional Application also notes that "[t]he use of micromirrors with analog deflection shows the coupling efficiency to be controlled on a channel-by-channel basis[,]" and shows "[t]he change in coupling efficiency with micromirror angle . . . in Figure 21" (*id.* at 5–6):

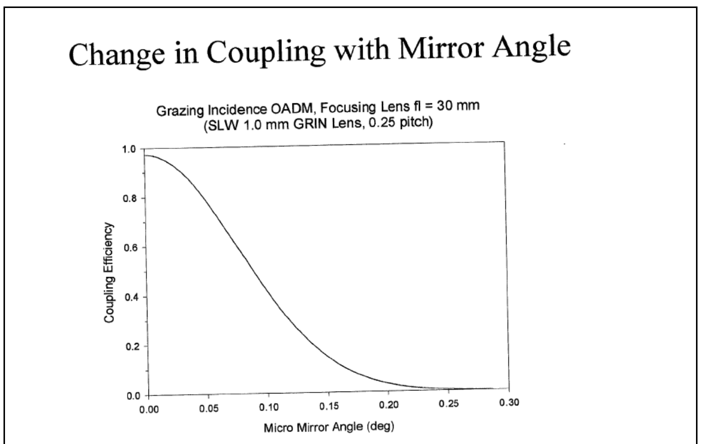


Figure 21 Capella Proprietary & Confidential

Id., Fig. 21.

2. The Common Specification

144. The common specification acknowledges that fiber-optic communication networks, wavelength division multiplexing ("WDM"), and optical add-drop multiplexers

("OADMs") were known in the art. '905 Patent at 1:45–58. The common specification provided the following description of prior art OADMs:

> An optical add-drop multiplexer (OADM) serves to selectively remove (or drop) one or more wavelengths from a multiplicity of wavelengths on an optical fiber, hence taking away one or more data channels from the traffic stream on the fiber. It further adds one or more wavelengths back onto the fiber, thereby inserting new data channels in the same stream of traffic. As such, an OADM makes it possible to launch and retrieve multiple data channels (each characterized by a distinct wavelength) onto and from an optical fiber respectively, without disrupting the overall traffic flow along the fiber. Indeed, careful placement of the OADMs can dramatically improve an optical communication network's flexibility and robustness, while providing significant cost advantages.

Id. at 1:58–2:4. The common specification acknowledged that "OADM[s] that make[] use of free-space optics" were known in the art, along with (1) ruled diffraction gratings, (2) and "binary micromachined mirrors . . . [e]ach . . . configured to operate between two discrete states[.]" *Id.* at 2:32–42 (discussing U.S. Patent No. 6,204,946 to Askyuk et al.). The common specification also acknowledged that OADMs using "input, output, drop and add ports" were known in the art, with each micromirror, "notwithstanding switchable [sic] between two discrete positions, either reflects its corresponding channel (coming from the input port) to the output port, or concomitantly reflects its channel to the drop port and an incident add channel to the output port." *Id.* at 3:12–23 (discussing U.S. Patent No. 5,906,133 to Tomlinson et al.).

145. The common specification also identified what it described as "the prevailing drawbacks suffered by the OADMs currently in the art":

> 1) The wavelength routing is intrinsically static, rendering it difficult to dynamically reconfigure these OADMs.
>
> 2) Add and/or drop channels often need to be multiplexed and/or demultiplexed, thereby imposing additional complexity and cost.

> 3) Stringent fabrication tolerance and painstaking optical alignment are required. Moreover, the optical alignment is not actively maintained, rendering it susceptible to environmental effects such as thermal and mechanical disturbances over the course of operation.
>
> 4) In an optical communication network, OADMs are typically in a ring or cascaded configuration. In order to mitigate the interference amongst OADMs, which often adversely affects the overall performance of the network, it is essential that the power levels of spectral channels entering and exiting each OADM be managed in a systematic way, for instance, by introducing power (or gain) equalization at each stage. Such a power equalization capability is also needed for compensating for non-uniform gain caused by optical amplifiers (e.g., erbium doped fiber amplifiers) in the network. There lacks, however, a systematic and dynamic management of the power levels of various spectral channels in these OADMs.
>
> 5) The inherent high cost and heavy optical loss further impede the wide application of these OADMs.

Id. at 3:33–58.

146. The common specification described utilizing "channel micromirrors," and described them as follows:

> The channel micromirrors are positioned such that each channel micromirror receives one of the spectral channels. The channel micromirrors are individually controllable and movable, e.g., continuously pivotable (or rotatable), so as to reflect the spectral channels into selected ones of the output ports. As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror". And each output port may receive any number of the reflected spectral channels.
>
> A distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that the motion, e.g., pivoting (or rotation), of each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port.

Id. at 4:9–26; *see also id.* at 7:17–27, 9:25–31. The common specification also disclosed that "[t]he channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting means known in the art." *Id.* at 4:33–36; *see also id.* at 9:22–25.

147. Figure 1C of the common specification "show[]ed a plot of coupling efficiency as a function of a channel micromirror's pivoting angle θ" (*id.* at 8:45–48):

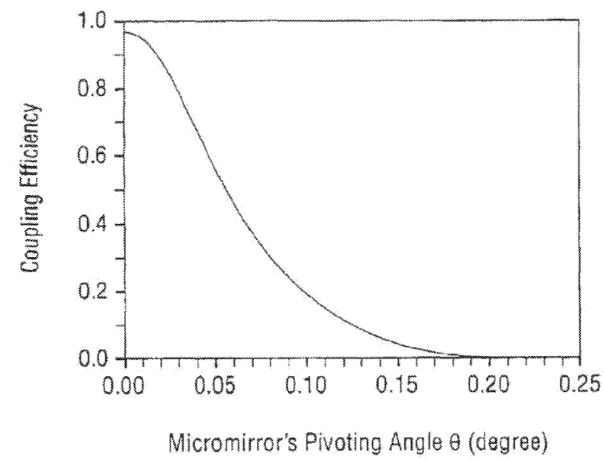
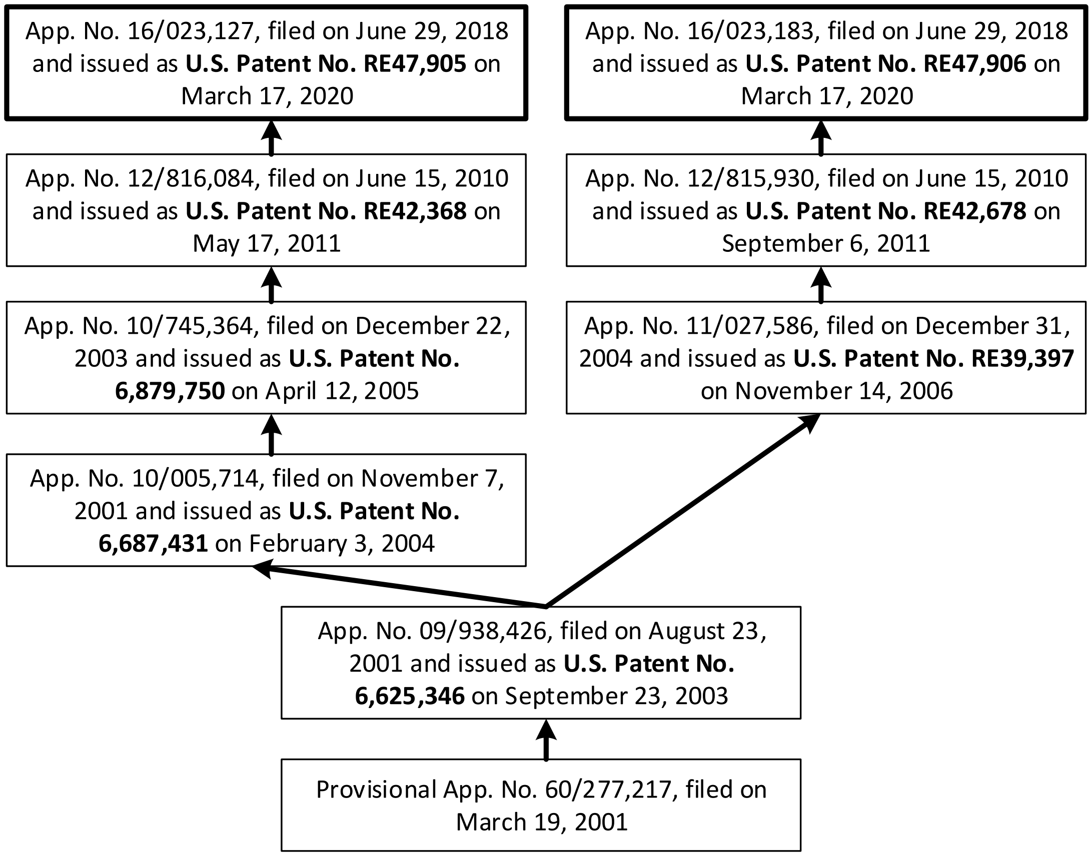


Fig. 1C

Id., Fig. 1C.

B. The Prosecution Histories

148. The Asserted Patents claim priority to a number of different applications. I have provided a visual representation of the priority chain below:



To the extent they were available, I have reviewed the prosecution histories for these applications.

1. <u>The IPR Proceedings of the Previous Patents</u>

149. It is my understanding that, in 2014 Capella previously asserted U.S. Patent Nos. RE42,368 (the "'368 Patent") and RE42,678 (the "'678 Patent") (collectively, the "Previously Asserted Patents") against a number of defendants, including Tellabs, Inc., Tellabs Operations Inc., and Coriant (USA) Inc. (which I understand are now part of Infinera) and Fujitsu Network Communications, Inc. It is also my understanding that a number of parties, including Coriant Operations, Inc. and Coriant (USA) Inc. (which I understand are now part of Infinera) and Fujitsu Network Communications, Inc., filed petitions with the U.S. Patent and Trademark Office's Patent Trial and Appeal Board ("PTAB") seeking *inter partes* review of the Previously

Asserted Patents. The PTAB issued six Final Written Decisions, finding the challenged claims of the Previously Asserted Patents obvious and cancelling them:

- *Cisco Sys., Inc., Coriant Corp., Coriant Operations, Inc., Coriant (USA) Inc., & Fujitsu Network Commc'ns, Inc. v. Capella Photonics, Inc.*, IPR2014-01166, Patent RE42,368 (PTAB), Paper 44 (Jan. 28, 2016 Final Written Decision) (Capella_Infinera_000045633);

- *Cisco Sys., Inc., Ciena Corp., Coriant Operations, Inc., Coriant (USA) Inc., & Fujitsu Network Commc'ns, Inc. v. Capella Photonics, Inc.*, IPR2014-01276, Patent RE42,678 E1 (PTAB), Paper 40 (Feb. 17, 2016 Final Written Decision) (Capella_Infinera_000048455);

- *Fujitsu Network Commc'ns, Inc., Coriant Operations, Inc., Coriant (USA) Inc., & Ciena Corp. v. Capella Photonics, Inc.*, IPR2015-00726, Patent RE 42,368 E (PTAB), Paper 38 (Sept. 28, 2016 Final Written Decision) (Capella_Infinera_000051408);

- *Fujitsu Network Commc'ns, Inc. v. Coriant Operations, Inc., Coriant (USA) Inc., & Ciena Corp. v. Capella Photonics, Inc.*, IPR2015-00727, Patent RE42,678 E (PTAB), Paper 36 (Sept. 28, 2016 Final Written Decision) (Capella_Infinera_000055287);

- *Lumentum Holdings, Inc., Lumentum, Inc., Lumentum Operations, LLC, Coriant Operations, Inc., Coriant (USA) Inc., Ciena Corp., Cisco Sys., Inc., & Fujitsu Network Commc'ns, Inc. v. Capella Photonics, Inc.*, IPR2015-00731, Patent RE42,368 (PTAB), Paper 51 (Sept. 29, 2016 Final Written Decision) (Capella_Infinera_000059179); and

- *Lumentum Holdings, Inc. v. Lumentum, Inc., Lumentum Operations, LLC, Coriant Operations, Inc., Coriant (USA) Inc., Ciena Corp., Cisco Sys., Inc., & Fujitsu Network Commc'ns, Inc. v. Capella Photonics, Inc.*, IPR2014-00739, Patent RE42,678 E (PTAB), Paper 50 (Oct. 14, 2016 Final Written Decision) (Capella_Infinera_000062723).

It is my understanding that Capella appealed each of these Final Written Decisions to the Federal Circuit, and the Federal Circuit summarily affirmed the PTAB's Final Written Decisions. *See* Capella_Infinera_000077380 (Notice of Entry of Judgment Without Opinion); Capella_Infinera_000077379 (Mandate). It is also my understanding that Capella asked the United States Supreme Court to review, and that the Supreme Court denied Capella's request. *See* Capella_Infinera_000077747 at 751 (denial of petition for writ of certiorari).

150. I have reviewed the Final Written Decisions, and I agree with the PTAB's ultimate findings that the cancelled claims were obvious and its analyses of (1) whether the references analyzed were prior art, (2) the teachings of the prior art, and (3) motivations to combine the prior art. I incorporate the Final Written Decisions into this report by reference. The PTAB specifically analyzed six prior art references:

- U.S. Patent No. 6,498,872 to Bouevitch et al. ("Bouevitch");
- U.S. Patent No. 6,798,941 to Smith et al. ("Smith")[13];
- U.S. Patent No. 5,661,591 to Lin et al. ("Lin");
- U.S. Patent No. 6,011,884 to Dueck et al. ("Dueck");
- U.S. Patent No. 6,442,307 to Carr et al. ("Carr");
- U.S. Patent No. 6,625,340 to Sparks et al. ("Sparks").

151. The following provides a high-level description of the PTAB's finding in these Final Written Decisions. Appendix E shows which prior art references the PTAB found taught the limitations of the cancelled claims. I incorporate the PTAB's findings described in Appendix E by reference.

a) IPR2014-01166, Patent RE42,368

152. In IPR2014-01166 for Patent No. RE42,368, the PTAB found that (1) claims 1–6, 9–11, 13, and 15–22 were obvious over Bouevitch, Smith, and Lin, and (2) claim 12 was obvious over Bouevitch, Smith, Lin, and Dueck. *See, e.g.*, Capella_Infinera_000045633 at 675.

[13] After Capella disputed Smith's priority date, arguing that Smith could not claim priority to a provisional application filed on September 22, 2000, the PTAB found against Capella and held that Smith was prior art to the Previously Asserted Patents. Capella_Infinera_000045633 (IPR2014-01166) at 648–53; Capella_Infinera_000048455 (IPR2014-01276) at 474–79. I have reviewed and agreed with the PTAB's analysis, and I incorporate by reference the PTAB's analysis of Smith's priority date.

The PTAB made the following findings with regard to why a POSITA would combine these prior art references. I have reviewed these findings and I agree with them, and I incorporate them by reference. For example:

- Technical differences between these prior art references could have been overcome by a POSITA. *Id.* at 662–63.
- Bouevitch does not teach away from using misalignment to control power. *Id.* at 664.
- The benefits of a two-axis mirror (such as that disclosed by Smith) over a one-axis mirror (such as that disclosed by Bouevitch) would have been apparent to a POSITA without hindsight. *Id.*
- It would have been obvious to try to combine the teachings of a two axis mirror (such as that disclosed by Smith) with a reference that teaches a one-axis mirror (such as that disclosed by Bouevitch) because "(1) there were only two solutions to the known need to deflect light beams with MEMS: 1-axis or 2-axis, (2) a person of ordinary skill would have had a high expectation of success to try two-axis mirror control in Bouevitch, and (3) the result of the combination would be predictable." *Id.* at 664–65.
- Combining the teachings of Smith and Lin would not be beyond the skill of a POSITA. *Id.* at 665.
- Incorporating the teaching of a two-axis mirror (such as that disclosed by Smith) with the teaching of a one-axis mirror (such as that disclosed by Bouevitch) was a simple substitution, because these mirrors were "known to be interchangeable," "Smith acknowledges this interchangeability," and Smith "identifies benefits to the use of a two-axis mirror." *Id.*
- "The asserted combination of Smith and Bouevitch and Lin yields a predictable result." *Id.*at 666.
- Applying the teachings of a two-axis mirror (such as that disclosed by Smith) to prior art that teaches a one-axis mirror (such as Bouevitch) "would have been beneficial 'because choosing only a single axis for both port selection and attenuation may result in dynamic fluctuations of power crosstalk between ports as attenuation level is varied,' would reduce 'the risk of the signal bleeding into a port that is adjacent to the output port along the switching axis, and would provide finer control over attenuation by allowing the use of the full dynamic range of the mirror tilt in the first axis for attenuation." *Id.* (citation omitted).

- "[T]he application of Smith to Bouevitch constitutes the use of known techniques to improve similar devices." *Id.*

- A POSITA "would have combined the teachings of Lin with Bouevitch and Smith because: (1) continuously controlled mirrors were known to be interchangeable with discrete-step mirrors; (2) continuously controlled mirrors allow arbitrary positioning of mirrors and can more precisely match the optimal coupling value; and (3) Lin specifically teaches that its analog, continuous MEMS mirrors would be useful in optical switching applications like Bouevitch's and Smith's ROADM devices." *Id.* at 666–67 (citations omitted).

- "[T]he use of analog continuous control was the known alternative to discrete (or step-wise) control, and would have been obvious to try and expected to work when applied to Bouevitch." *Id.* at 667.

- A POSITA would have been motivated to combine the control disclosed by Smith and the optical power monitor disclosed by Bouevitch "as an alternative to the 'external feedback' for power control that Bouevitch explains should be eliminated[.]" *Id.* at 669.

- A POSITA "would appreciate that the feedback-driven control of Smith would improve the precision of the mirror-based switching system of Bouevitch." *Id.* (citation and internal quotation marks omitted).

- "[I]t would have been obvious to try the predetermined power settings of Smith within Bouevitch, because Smith teaches that predetermined power values could make up for inherent problems in optical switching, such as power variations from optical amplifiers and manufacturing and environmental variations, and because WDM systems must maintain a significant degree of uniformity of power levels across the WDM spectrum." *Id.* (citation and internal quotation marks omitted).

- A POSITA would be motivated to combine the ruled diffraction grating in Dueck with Bouevitch, even if it "may not be readily be incorporated." *Id.* at 674–75.

b) IPR2015-00726, Patent RE42,368

153. In IPR2015-00726 for Patent No. RE42,368, the PTAB found that (1) claims 1, 2, 5, 6, 9–12, and 15–21 were obvious over Bouevitch and Carr, and (2) claims 1–4, 17, and 22 were obvious over Bouevitch and Sparks. *See, e.g.*, Capella_Infinera_000051408 at 433. The PTAB made the following findings with regard to why a POSITA would combine these prior

art references. I have reviewed these findings and I agree with them, and I incorporate them by reference. For example:

- Using two-axis mirrors (such as those disclosed by Sparks) in Bouevitch's system to control power through intentional misalignment would not "destroy[ed] Bouevitch's principle of operation[,]" and Bouevitch recognizes using misalignment for power control. *See id.* at 425–27.

- Combining Bouevitch and Carr was not improper hindsight, and did not require knowledge beyond the level of a POSITA. *See id.* at 427.

- Wavelength-selective switches were known and described in the prior art before March 17, 2001. *Id.* at 427–28.

- Bouevitch and Carr, rather than Capella's patents (here, specifically, the '368 Patent), provides the motivations to combine these references. *See id.* at 428.

- The benefits of a two-axis mirror (such as that disclosed by Carr) would have been apparent to a POSITA without hindsight, and it would have been obvious to try because "(1) there were only two solutions to the known need to deflect light beams with MEMS: 1-axis or 2-axis; (2) a person of ordinary skill would have had a high expectation of success to try two-axis mirror control in Bouevitch; and (3) the result of the combination would be predictable." *See id.* at 428–29 (citation omitted).

- Combining the teachings of Bouevitch and Carr would not be beyond the skill of a skilled artisan. *See id.*

- Incorporating a teaching of a two-axis mirror (such as that disclosed by Carr) with a reference teaching a one-axis mirror (such as Bouevitch) is "a simple substitution, notwithstanding the fact that it may require substantial engineering as a practical matter." *Id.* at 429.

- The combination of Bouevitch and Carr "yields a predictable result." *Id.*

- The rationale for combining "Bouevitch and Carr similarly applies to the combination of Bouevitch and Sparks." *Id.* at 431.

- A POSITA "would have been motivated to combine the two axis movable MEMS mirrors of Sparks in the COADM of Bouevitch based on the teachings of the references, common sense and knowledge generally available to a [person of ordinary skill], as the proposed combination would merely be substituting known elements to yield predictable results[.]" *Id.* (citation and internal quotation marks omitted).

- "Using the known two-axis mirrors of Sparks in the Bouevitch COADM entails nothing more than the use of known techniques to improve similar devices." *Id.* (citation and internal quotation marks omitted).

- Incorporating a two-axis mirror (such as that disclosed by Sparks) into a reference that uses a one-axis mirror (such as Bouevitch) "is a simple substitution, notwithstanding the fact that it may require substantial engineering as a practical matter." *Id.* at 432.

- Incorporating a two-axis mirror (such as that disclosed by Sparks) into a reference that uses a one-axis mirror (such as Bouevitch) "yields a predictable result." *Id.*

c) IPR2015-00731, Patent RE42,368

154. In IPR2015-00731 for Patent No. RE42,368, the PTAB found that (1) claims 1–6, 9–11, 13, and 15–22 were obvious over Bouevitch, Sparks, and Lin, and (2) claim 12 was obvious over Bouevitch, Sparks, Lin, and Dueck. *See, e.g.*, Capella_Infinera_000059179 at 216. The PTAB made the following findings with regard to why a POSITA would combine these prior art references. I have reviewed these findings and I agree with them, and I incorporate them by reference. For example:

- The benefits of a two-axis mirror (such as that disclosed by Sparks) "would be apparent to one of skill in the art without hindsight." *Id.* at 204–05.

- "[T]wo-axis mirrors were known and cited during prosecution." *Id.*

- Bouevitch does not teach away from misalignment for power control. *See id.* at 206.

- Bouevitch and Sparks are not "incompatible technologies." *See id.* at 206–07 (citation and internal quotation marks omitted).

- The costs of using a two-axis mirror (such as that disclosed by Sparks) do not outweigh the benefits of using such a mirror, compared to a one-axis mirror (such as that disclosed by Bouevitch. *See id.*

- It would have been obvious to try to use a two-axis mirror (such as that disclosed by Sparks) with a reference disclosing a one-axis mirror (such as Bouevitch) because it would have been obvious to try, at least because "(1) there were only two solutions to the known need to deflect light beams with MEMS: 1-axis or 2-axis; (2) a person of ordinary skill would have had a

high expectation of success to try two-axis mirror control in Bouevitch; and (3) the result of the combination would be predictable." *Id.* at 207 (citations and internal quotation marks omitted).

- The teachings of Sparks and Lin would not be beyond the skill of a skilled artisan. *See id.* at 207–08.

- A POSITA would be motivated to combine Lin with Bouevitch and Sparks because "Lin specifically teaches that its analog, continuous MEMS mirrors would be useful in optical switching applications like Bouevitch's and Sparks' optical switch devices." *Id.* (citations omitted).

- Incorporating a two-axis mirror (such as that disclosed by Sparks) with a reference that uses a one-axis mirror (such as Bouevitch) "is a simple substitution, notwithstanding the fact that it may require substantial engineering as a practical matter." *Id.* at 208.

- The combination of Sparks and Bouevitch and Lin "yields a predictable result." *Id.*

- Sparks, Bouevitch, and Lin "all address optical signal switches," "the principles of operation of the MEMS-based actuating mirrors are essentially the same except the mirrors of Sparks are actuatable in one more axis than those of Bouevitch," and "a two-axis mirror in place of a one-axis mirror would yield a predictable result of the same functionality (e.g., movement of a reflective surface in a first axis) yet with more control (e.g., the reflective surface moving in a second axis in similar manner as the movement in the first axis." *Id.* at 208–09 (citations and internal quotation marks omitted).

- "Continuously controlled analog mirrors" (such as those disclosed by Lin and Bouevitch) were recognized as interchangeable with discrete step mirrors." *Id.* at 209 (citations and internal quotation marks omitted).

- "[T]he feedback-driven control of Sparks would improve the precision of the mirror-based switching system of Bouevitch." *Id.* at 212 (citations and internal quotation marks omitted).

- "[I]t would have been obvious to try the predetermined power settings of Sparks within Bouevitch, 'because there are only a limited set of types of power settings to use: predetermined and not-predetermined." *Id.* (citations and internal quotation marks omitted).

- The '368 Patent states that a "skilled artisan will know how to implement a suitable spectral monitor[.]"

- A POSITA would be motivated to combine the ruled diffraction grating in Dueck with Bouevitch, even if it "may not be readily be incorporated." *Id.* at 674–75.

d) IPR2014-01276, Patent RE42,678

155. In IPR2014-01276 for Patent No. RE42,678, the PTAB found that (1) claims 1–4, 9, 10, 13, 19–23, 27, 44–46, and 61–65 were obvious over Bouevitch, Smith, and Lin, and (2) claims 17, 29, and 53 were obvious over Bouevitch, Smith, Lin, and Dueck. *See, e.g.*, Capella_Infinera_000048455 at 505. The PTAB made the following findings with regard to why a POSITA would combine these prior art references. I have reviewed these findings and I agree with them, and I incorporate them by reference. For example:

- To the extent the combination of a two-axis mirror (such as that disclosed by Smith) with a reference disclosing a one-axis mirror (such as Bouevitch) would have presented any problems, they could have been overcome by a POSITA. *See id.* at 491.

- Bouevitch does not teach away from using misalignment to control power. *See id.* at 492.

- The benefits of using a two-axis mirror (such as that disclosed by Smith) with a reference disclosing a one-axis mirror (such as Bouevitch) "would be apparent to one of skill in the art without hindsight." *Id.* at 492–93.

- It would have been obvious to a POSITA to try to use a two-axis mirror (such as that disclosed by Smith) with a reference disclosing a one-axis mirror (such as Bouevitch) because "(1) there were only two solutions to the known need to deflect light beams with MEMS: 1-axis or 2-axis, (2) a person of ordinary skill would have had a high expectation of success to try two-axis mirror control in Bouevitch, and (3) the result of the combination would be predictable." *Id.* at 493.

- Applying analog control (such as that disclosed by Lin) to a two-axis mirror (such as that disclosed by Smith) would have been within the skill of a POSITA. *See id.*

- Incorporating a two axis-mirror (such as that disclosed by Smith) with a reference that uses a one-axis mirror (such as Bouevitch) "is a simple substitution, notwithstanding the fact that it may require substantial engineering as a practical matter." *See id.* at 493–94.

- "Single-axis and two-axis mirrors were known to be interchangeable." *Id.* at 494.

- Smith "not only expressly acknowledges" the interchangeability of single-axis and two-axis mirrors, "but also identifies benefits to the use of a two-axis mirror: '[i]n comparison to the two-axis embodiment, single axis systems may be realized using simpler, single axis MEMS arrays but suffer from increased potential for crosstalk between channels.'" *Id.* (citations omitted).

- Combining Smith and Bouevitch and Lin "yields a predictable result." *Id.*

- Applying a two-axis mirror (such as that disclosed by Smith) to a reference using a one-axis mirror (such as Bouevitch) "would have been beneficial because choosing only a single axis for both port selection and attenuation may result in dynamic fluctuations of power crosstalk between ports as attenuation level is varied, would reduce the risk of the signal bleeding into a port that is adjacent to the output port along the switching axis, and would provide finer control over the attenuation value by allowing the use of the full dynamic range of the mirror tilt in the first axis for attenuation." *Id.* (internal quotation marks and citations omitted).

- "[T]he application of Smith to Bouevitch constitutes the use of known techniques to improve similar devices." *Id.* at 494–95.

- A POSITA would have combined the teachings of Lin with Bouevitch and Smith because (1) continuously controlled mirrors were known to be interchangeable with discrete-step mirrors; (2) continuously controlled mirrors allow arbitrary positioning of mirrors and can more precisely match the optimal coupling value; and (3) Lin specifically teaches that its analog, continuous MEMS mirrors would be useful in optical switching applications like Bouevitch's and Smith's ROADM devices." *Id.* at 495 (citation omitted).

- The '678 Patent "expressly recognizes that the additional features of claims 2–4 [of the '678 Patent] were 'known in the art' to a skilled artisan and would have been obvious to implement." *Id.* at 496.

- It would have been obvious to a POSITA to combine Smith's controller with Bouevitch's optical power monitor as an alternative to external feedback for power control. *See id.* at 497–98.

- A POSITA "would appreciate that the feedback-driven control of Smith would improve the precision of the mirror-based switching system of Bouevitch." *Id.*

- "[I]t would have been obvious to try the predetermined power settings of Smith with Bouevitch, because 'Smith teaches that predetermined power values could make up for inherent problems in optical switching, such as

power variations from optical amplifiers and manufacturing and environmental variations, and because 'WDM systems must maintain a significant degree of uniformity of power levels across the WDM spectrum." *Id.* (citations omitted).

- A POSITA would be motivated to apply the optical sensors taught by Smith to Bouevitch to "provide a more accurate measurement of the devices output power and to provide increased accuracy for power control." *Id.* at 499 (citations and internal quotation marks omitted).

- A POSITA would be motivated to use Dueck's ruled diffraction grating with Bouevitch, even if it could not be readily incorporated. *Id.* at 504–05.

- "[A] ruled diffraction grating could have been used in Bouevitch, as well as a holographic diffraction grating, or an echelle grating, as they are all reasonable substitutes for one another and would be expected to work." *Id.* at 505 (citations omitted).

e) IPR2015-00727, Patent RE42,678

156. In IPR2015-00727 for Patent No. RE42,678, the PTAB found that (1) claims 1, 9, 10, 13, 17, 19, 44, 53, 61, 64, and 65 were obvious over Bouevitch and Carr, and (2) claims 1–4, 19–23, 27, 29, 44–46, and 61–63 were obvious over Bouevitch and Sparks. *See, e.g.*, Capella_Infinera_000055287 at 315. The PTAB made the following findings with regard to why a POSITA would combine these prior art references. I have reviewed these findings and I agree with them, and I incorporate them by reference. For example:

- Providing single-axis MEMs mirrors (such as those disclosed in Bouevitch) with two-axis tilt capacity (such as those disclosed in Carr) "enables the spatial positioning of returning beams in both transverse directions at the face of [a microlens array], thereby reducing errors in system alignment." *See id.* at 307 (citations and internal quotation marks omitted).

- There were only two options for tilting MEMS mirrors: one-axis and two-axis mirrors, and a POSITA would have a high expectation of success controlling a two-axis mirror (such as that disclosed in Carr) in a reference that teaches controlling a one-axis mirror (such as Bouevitch). *See id.* (citations omitted).

- Two-axis mirrors were available by the '678 Patent's priority date. *Id.*

- Bouevitch does not teach away from misalignment for power control. *See id.* at 308–09.

- "[W]avelength-selective switches were known and described prior to [the '678 Patent's] priority date." *Id.* at 309–10.

- Bouevitch and Carr—particularly Carr's description of a "two-axis MEMS device with highly accurate lateral alignment that permits precise control of the mirrors, a more robust structure, greater packing density, larger mirror sizes, and larger mirror rotation angles that are conventionally obtained and easier electrical connection to the mirrors, and Bouevitch's description of "alignment problems and concerns with small temperature fluctuations"—sufficiently provide motivation for combining one another, "rather than the '678 Patent." *See id.* at 310.

- "[T]he benefits of a two-axis mirror" (such as that disclosed by Carr) "would be apparent to one of skill in the art without hindsight." *Id.* at 310–11.

- It would have been obvious to try using a two-axis mirror (such as that disclosed by Carr) with a reference that uses a one-axis mirror (such as Bouevitch) because "(1) there were only two solutions to the known need to deflect light beams with MEMS: 1-axis or 2-axis, (2) a person of ordinary skill would have had a high expectation of success to try two-axis mirror control in Bouevitch, and (3) the result of the combination would be predictable." *Id.* (citations and internal quotation marks admitted).

- Combining a reference teaching a two-axis mirror (such as Carr) with a reference teaching a one-axis mirror (such as Bouevitch) would not be "beyond the skill of a skilled artisan, even if feats of engineering are contemplated." *Id.*

- Incorporating the teaching of a two-axis mirror (such as that disclosed by Carr) with a reference teaching a one-axis mirror (such as Bouevitch) "is a simple substitution, notwithstanding the fact that it may require substantial engineering as a practical matter." *Id.*

- Combining a reference teaching a two-axis mirror (such as Carr) with a reference teaching a one-axis mirror (such as Bouevitch) "yields a predictable result." *See id.* at 311–12.

- The use of intentional misalignment techniques to control power, such as those taught by Carr and Sparks, do not conflict with Bouevitch's optical design. *See id.* at 314.

- The motivation to combine Bouevitch and Sparks comes from the references themselves, not from the '678 Patent, and does not amount to impermissible hindsight. *See id.*

- Incorporating the teaching of a two-axis mirror (such as that disclosed by Sparks) with a reference teaching a one-axis mirror (such as Bouevitch) "is a

simple substitution, notwithstanding the fact that it may require substantial engineering as a practical matter." *Id.*

- Combining Bouevitch and Sparks "yields a predictable result." *Id.* at 314–15.

f) IPR2015-00739, Patent RE42,678

157. In IPR2015-00739 for Patent No. RE42,678, the PTAB found that (1) claims 1–4, 9, 10, 13, 19–23, 27, 44–46,and 61–65 were obvious over Bouevitch, Sparks, and Lin, and (2) claims 17, 29, and 53 were obvious over Bouevitch, Sparks, Lin, and Dueck. *See, e.g.*, Capella_Infinera_000062723 at 766. The PTAB made the following findings with regard to why a POSITA would combine these prior art references. I have reviewed these findings and I agree with them, and I incorporate them by reference. For example:

- Applying the teaching of a two-axis mirror (such as that disclosed by Sparks) to a reference that teaches a one-axis mirror (such as Bouevitch) "(1) is a simple substitution of one known element for another yielding predictable results, (2) is the use of a known technique to improve similar devices, (3) would be obvious to try as there are only two options for tilting MEMS mirrors: one-axis and two-axis mirrors, and (4) would be motivated to help ensure that all channels have nearly equivalent power and to overcome manufacturing deviations by being actuatable to adjust for any unintentional misalignment in two axes." *See id.* at 749 (citations omitted).

- A POSITA would be motivated to apply the teaching of continuous, analog control (such as that disclosed by Lin) to references that taught controlling mirrors (such as Bouevitch and Sparks) because "(1) continuously controlled mirrors were known to be interchangeable with discrete step mirrors; (2) continuously controlled mirrors allow arbitrary positioning of mirrors and can more precisely match the optimal coupling value; and (3) Lin specifically teaches that its analog, continuous MEMS mirrors would be useful in optical switching applications like Bouevitch's and Spark's optical switch devices." *Id.* at 749–50 (citations omitted).

- A POSITA would "be motivated to use the 2-axis system of Sparks within the system of Bouevitch for power control." *Id.* at 750 (citations omitted).

- The benefits of a two-axis mirror (such as that disclosed by Sparks) "would be apparent to one of skill in the art without hindsight." *Id.* at 751.

- A POSITA "would have been capable of overcoming any problems presented by technical issues" associated with replacing a single-axis mirror with a two-axis mirror. *See id.*

- "Two-axis mirrors were known and cited during prosecution" of the '368 Patent. *Id.*

- Bouevitch does not teach away from using misalignment for power control. *See id.* at 752–53.

- The costs of incorporating the teachings of a two-axis mirror (such as that disclosed by Sparks) with a reference teaching a single-axis mirror (such as Bouevitch) would not outweigh the benefits. *See id.* at 753.

- It would have been obvious to try incorporating the teachings of a two-axis mirror (such as that disclosed by Sparks) with a reference teaching a single-axis mirror (such as Bouevitch) because "(1) there were only two solutions to the known need to deflect light beams with MEMS: 1-axis or 2-axis"; (2) a person of ordinary skill would have had a high expectation of success to try two-axis mirror control in Bouevitch; and (3) the result of the combination would be predictable." *Id.* (citations omitted).

- Combining the teachings of Sparks and Lin would not be beyond the skill of a POSITA. *See id.* at 753–54.

- "Lin specifically teaches that its analog, continuous MEMS mirrors would be useful in optical switching applications like Bouevitch's and Sparks' optical switch devices." *Id.* at 754.

- Substituting a one-axis mirror (such as that disclosed by Bouevitch) with a two-axis mirror (such as that disclosed by Sparks) "is a simple substitution, notwithstanding the fact that it may require substantial engineering as a practical matter." *Id.*

- Combining Sparks, Bouevitch, and Lin "yields a predictable result." *Id.*

- Sparks, Bouevitch, and Lin "all address optical signal switches," "the principles of operation of the MEMS-based actuating mirrors are essentially the same except that the mirrors of Sparks are actuatable in one more axis than those of Bouevitch," and "a two-axis mirror in place of a one-axis mirror would yield a predictable result of the same functionality (e.g., movement of a reflective surface in a first axis) yet with more control (e.g., the reflective surface moving in a second axis in similar manner as the movement in the first axis)." *Id.* at 754–55 (citations and internal quotation marks omitted).

- "[C]ontinuously controlled analog mirrors were recognized as interchangeable with discrete step mirrors." *Id.* at 755.

- The ’678 Patent “expressly recognizes” that the additional features of claims 2–4 of the ’678 Patent “were ‘known in the art’ to a skilled artisan and would have been obvious to implement.” *Id.* at 757.

- A feedback loop (such as that disclosed by Sparks) is a “known alternative” to “external feedback” (such as that disclosed by Bouevitch). *See id.* at 758.

- Using a spectral monitor and processing unit (such as that disclosed by Sparks) within a ROADM (such as that disclosed by Bouevitch) “would have been the mere combining of known prior art elements according to their known methods to yield predictable results.” *Id.*

- Applying the optical sensors taught by Sparks to other prior art references (such as Bouevitch) would “help achieve the equalization of the powers levels.” *See id.* at 760.

- “[A] ruled diffraction grating” (such as that disclosed in Dueck) “could have been used in Bouevitch, as well as holographic diffraction grating, or an echelle grating, as they are all reasonable substitutes for one another and would be expected to work.” *Id.* at 765.

- A POSITA would be motivated to combine the ruled diffraction grating in Dueck with Bouevitch, even if it “may not be readily be incorporated.” *See id.* at 765.

2. <u>The Prosecution Histories of the Asserted Patents</u>

158. After the PTAB found certain claims of the ’368 and ’678 Patents obvious, Capella filed applications for reissue applications, which ultimately issued as the Asserted Patents. *See generally* ’905 and ’906 Patents. I have compared the claims that ultimately issued in the ’906 and ’906 Patents to the claims that were obvious (and cancelled by the PTAB) in the ’368 and ’678 Patents. Appendix F to this report shows the changes in the claims, and I incorporate Appendix F by reference. I note that, for all of the claims in the ’905 and ’906 Patents based on claims that were cancelled by the PTAB, the only substantive changes appear to be the narrowing of certain “ports” terms to “<u>fiber collimator</u> ports” or “fiber collimators providing<u> and serving as</u> ports.”

C. Testimony Related to the Asserted Patents and the Previously Asserted Patents

159. I have reviewed the transcripts of the depositions of Dr. Jeffrey Wilde, Dr. Tai Chen, and Dr. Joseph Davis, named inventors of the Asserted Patents. I have also reviewed the transcripts of the depositions of Dr. Sergienko, whom Capella used as an expert for claim construction in this case and used as an expert during the *inter partes* review proceedings for the previous patents.

1. <u>Testimony By Dr. Jeffrey Wilde, Named Inventor</u>

160. I note that Dr. Wilde was the only inventor named on the Provisional Application. *See* Provisional Application at 1. See Dr. Wilde testified that he had a "very, very generic and very general" idea of "invention":

> Okay. Well, there were a lot of questions about invention: Did I invent this? Did I invent that? Was I the first to invent? Let me just tell you, my idea and understanding of invention is I have -- it's really sort of an idea I've come up with. I'm not saying it's the first, the best, duplicative of certain components. It's just my idea is a very -- invention, in definition, is very, very generic and very general.
>
> So I just want to make that clear, when you were asking about my inventions and inventorship, I'm thinking in very broad terms. Not in the context of claims and what's legal, what's not legal. I'm just -- I'm just an engineer. I came up with an idea, wrote it down. That's it. Call it an invention. Is it patentable or not? That's a separate issue, right.

Wilde Depo. Tr. at 154:8–24 (Dec. 10, 2020). Dr. Wilde could not recall whether the alleged invention solved any problems found in the prior art or how it compared to the prior art:

> Q. And how did your invention compare to what was already known in the prior art?
>
> . . .
>
> THE WITNESS: I don't recall.

> . . .
>
> Q. Did your inventions solve any problems that were found in the prior art?
>
> . . .
>
> THE WITNESS: I don't recall.

Id. at 78:9–17.

> Q. Do you know how the invention described in the '906 patent compared to what was known in the prior art?
>
> . . .
>
> THE WITNESS: Today I don't recall.
>
> . . .
>
> Q. Do you know whether the '906 patent solved any problems in the prior art?
>
> . . .
>
> THE WITNESS: Again, I think I testified that I don't recall the prior art, so I can't answer.

Id. at 82:2–13. Additionally, Dr. Wilde did not know whether the invention had any new features compared to the prior art:

> Q. And do you know whether the invention described in the '906 patent had any new features compared to the prior art?
>
> . . .
>
> THE WITNESS: No.

Id. at 82:15–19.

161. Dr. Wilde confirmed that he did not invent various concepts already found in the prior art, including (1) "wavelength-selective switch[es] that use channel micromirrors"; (2) "channel micromirrors"; (3) "beam-deflecting elements"; (4) "controlling beam-deflecting elements in two dimensions"; (5) "two-dimensional MEMS mirrors"; (6) "fiber collimators";

(7) "quarter-wave plates"; (8) "wavelength-selective switch[es] that used quarter-wave plates"; (9) "wavelength-selective switch[es] that used focusing lenses"; (10) "reconfigurable add-drop multiplexer[s]"; and (11) "reconfigurable add-drop multiplexer[s] that used an auxiliary wavelength-selective switch":

> Q. And did you invent the first wavelength-selective switch to use channel micromirrors?
>
> . . .
>
> A. I don't think I did.

Id. at 111:14–20.

> Q. Were you the first to invent channel micromirrors generally?
>
> THE WITNESS: No. . . .

Id. at 112:3–9.

> Q. Were you the first to invent beam-deflecting elements?
>
> . . .
>
> THE WITNESS: No.

Id. at 112:20–23.

> Q. Were you the first to invent controlling beam-deflecting elements in two dimensions?
>
> . . .
>
> THE WITNESS: I didn't invent two-dimensional MEMS mirrors, no.

Id. at 112:25–113:4.

> Q. Were you the first to invent fiber collimators?
>
> A. No.

Id. at 113:6–8.

> Q. Were you the first to invent quarter-wave plates?

> A. No.

Id. at 113:24–114:1.

> Q. Were you the first to invent a wavelength-selective switch that used channel micromirrors?
>
> . . .
>
> THE WITNESS: Let me look.
>
> So if we look at Figure 6
>
> . . .
>
> A. -- which is a drawing taken from the paper by Joe Ford.
>
> . . .
>
> A. My recollection is there's a plane shown here, lambda D multiplex device plane. My vague recollection is that there is a MEMS mirror or mirror array in that location. So the answer to your question would be no.

Id. at 116:21–117:11.

> Q. Were you the first to invent a wavelength-selective switch that used quarter-wave plates?
>
> A. I think the answer is self-explanatory if you look at Figure 6, or do I need to help you?
>
> Q. I see lots of different lenses. Optics isn't my specialty. If you could just point me to the quarter-wave plate, that would be helpful.
>
> A. It's the component labeled "quarter-wave plate."

Id. at 119:4–13.

> Q. Were you the first to invent a wavelength-selective switch that used focusing lenses?
>
> A. The answer is self-explanatory.
>
> . . .
>
> Q. I'm sure you'll point me back to Figure 6.

> A. I'm sure you're correct.

Id. at 120:6–13.

> Q. And were you the first to invent a reconfigurable add-drop multiplexer?
>
> . . .
>
> THE WITNESS: No.

Id. at 120:14–17.

> Q. And were you the first to invent a reconfigurable add-drop multiplexer that used an auxiliary wavelength-selective switch?
>
> THE WITNESS: I don't know what that means, so I would say no.

Id. at 120:19–24.

162. Dr. Wilde also stated that he did not know whether certain other concepts were already known in the prior art, including (1) "wavelength-selective switch[es] [that] use[d] channel micromirrors that were pivotal about two axes"; (2) "using channel micromirrors for power control"; (3) "fiber collimator ports"; (4) "continuously controlling channel micromirrors"; (6) "individually controlling micromirrors"; (7) "wavelength-selective switch[es] that used fiber collimator ports"; (8) "wavelength-selective switch[es] that used fiber collimator ports and used channel micromirrors for power control"; (9) "wavelength-selective switch[es] that used fiber collimator ports and used controllable channel micromirrors"; (10) "wavelength-selective switch[es] that used fiber collimator ports and used continuously controllable channel micromirrors"; (11) "wavelength-selective switch[es] that used fiber collimator ports and used individually controllable channel micromirrors"; (12) "wavelength-selective switch[es] that used fiber collimator ports and used individually controllable channel micromirrors"; and (13) "wavelength-selective switch[es] that used fiber collimator ports and used individually and continuously controllable channel micromirrors for power control":

> Q. Did you invent the first wavelength-selective switch to use channel micromirrors that were pivotal about two axes?
>
> . . .
>
> THE WITNESS: I don't know.

Id. at 111:22–112:1.

> Were you the first to invent using channel micromirrors for power control?
>
> . . .
>
> THE WITNESS: I don't know.

Id. at 112:15–18.

> Q. Were you the first to invent fiber collimator ports?
>
> . . .
>
> THE WITNESS: I don't know.

Id. at 113:9–12.

> Q. Were you the first to invent continuously controlling channel micromirrors?
>
> . . .
>
> THE WITNESS: I don't know.

Id. at 113:14–17.

> Q. Were you the first to invent individually controlling channel micromirrors?
>
> . . .
>
> THE WITNESS: I don't know.

Id. at 113:19–22.

> Q. Were you the first to invent a wavelength-selective switch that used fiber collimator ports?
>
> . . .

> THE WITNESS: I don't know.

Id. at 116:15–19.

> Q. . . . Were you the first to invent a wavelength-selective switch that used fiber collimator ports and used channel micromirrors for power control?
>
> A. I don't know.

Id. at 117:12–17.

> Q. Were you the first to invent a wavelength-selective switch that used fiber collimator ports and used controllable channel micromirrors?
>
> . . .
>
> THE WITNESS: Yeah, I don't know.

Id. at 117:18–23.

> Q. Were you the first to invent a wavelength-selective switch that used fiber collimator ports and used continuously controllable channel micromirrors?
>
> . . .
>
> THE WITNESS: I don't know.

Id. at 117:25–118:5.

> Q. Were you the first to invent a wavelength-selective switch that used fiber collimator ports and used individually controllable channel micromirrors?
>
> . . .
>
> THE WITNESS: I don't know.

Id. at 118:7–12.

> Q. Were you the first to invent a wavelength-selective switch that used fiber collimator ports and used individually and continuously controllable channel micromirrors?
>
> . . .

THE WITNESS: I don't know.

Id. at 118:14–19.

Q. Were you the first to invent a wavelength-selective switch that used fiber collimator ports and used individually and continuously controllable channel micromirrors for power control?

. . .

THE WITNESS: I don't know.

Id. at 118:21–19:2.

2. Testimony by Dr. Tai Chen, Named Inventor

163. I note that Dr. Chen did not sign a declaration purporting to be an inventor until March 5, 2002, nearly a year after the Provisional Application was filed. *See* Capella_Infinera_000052581 (Prosecution History for U.S. Patent No. 6,687,431) at 643. Dr. Chen testified that optical add-drop multiplexers are a "very basic network element," and that he was aware of them before joining Capella:

Q. And who were you working for when you were focused on that type of optical switching?

A. It was a company called Cinta Networks.

Q. And did you study reconfigurable add-drop multiplexers before you started working at Capella?

. . .

THE WITNESS: I would not say that I study an optical add-drop multiplexer, but an optical add-drop multiplexer is a basic network element in the public network, so I -- I'm definitely familiar with it. I don't have to study it.

. . .

Q. And you were familiar with it before you joined Capella?

A. It's a very basic network element, so I'm familiar with it, yes, from that point of view. Everybody working in an optical network area knows 1 about that type of thing, yes.

Chen Depo. Tr. At 31:9–32:1. He also testified that he believed Capella had invented the first "wavelength separating and routing apparatus" because he "was not aware of any existing product that works like the invention . . . that was filed":

> Q. And do you believe that you invented anything new in the field of wavelength selective switches?
>
> . . .
>
> THE WITNESS: The product is actually not called a wavelength selective switch. At that time, wavelength selective switch was not a product. I think it became a product that's familiar to people around 2005.
>
> This patent was filed in 2001, and we called it a wavelength separating and routing apparatus, so I think -- I thought, at that time, it was novel. It was an invention, yes.
>
> Q. Thank you. That clarification was helpful. So you believe that you invented the first wavelength separating and routing apparatus?
>
> . . .
>
> THE WITNESS: It is an invention, yes, new.
>
> . . .
>
> Q. And are you aware of any wavelength separating and routing apparatuses that existed --
>
> A. At that time?
>
> Q. -- before 2001?
>
> A. No.
>
> Q. And how do you think that your wavelength separating and routing apparatus was new, compared to what already existed in 2001?
>
> . . .
>
> THE WITNESS: I was not aware of any existing product that works like the invention that was -- that was filed. I wasn't aware of any such a product.

Id. at 32:2–33:10. Prior to 2001, Dr. Chen did not "review [] publications describing optical switches" or "look at any patents" to determine whether the wavelength selective switch was actually novel:

> Q. And had you done any review of publications describing optical switching prior to 2001?
>
> A. No, because what we are doing, I believe nobody else has done. I was not aware of any product, and I was not the kind of person that scanned and read the literature to imitate other people's work.
>
> Q. And did you look at any patents that discussed optical switching, prior to 2001?
>
> A. Patents are very difficult to read, and I was not of a mind to go around reading patents, no.
>
> I think patents are an art, and I'm an engineer.
>
> Q. So is it your belief that you invented the first wavelength separating and routing apparatus, because no one else had built one before?
>
> A. I have -- I'm not arrogant enough to say that, but I just wasn't aware of any.

Id. at 34:14–35:6.

3. Testimony by Dr. Joseph Davis, Named Inventor

164. I note that Dr. Davis did not sign a declaration purporting to be an inventor until December 12, 2004, over three-and-a-half years after the Provisional Application was filed. *See* Capella_Infinera_000077939 (Prosecution History for U.S. Patent No. 6.879,750) at 965. Dr. Davis could not remember whether any part of the alleged invention was new compared to the prior art:

> Q And what about that invention was not already found in the prior art?
>
> . . .
>
> THE WITNESS: I just don't recall anymore.

Davis Depo. Tr. At 48:17–20 (Feb. 18, 2021).

> Q Was Capella the first to invent an optical add-drop multiplexer?
>
> . . .
>
> THE WITNESS: I don’t recall.
>
> . . .
>
> Q Was Capella the first to invent a reconfigurable optical add-drop multiplexer?
>
> A I don't --
>
> . . .
>
> THE WITNESS: I don’t recall.
>
> . . .
>
> Q Was Capella the first to invent MEMS micromirrors?
>
> . . .
>
> THE WITNESS: I don't recall.
>
> . . .
>
> Q Was Capella the first to invent channel micromirrors?
>
> . . .
>
> THE WITNESS: I just don't recall.
>
> . . .
>
> Q Was Capella the first to invent channel micromirrors that were pivotable about two axes?
>
> . . .
>
> THE WITNESS: I don't recall.
>
> . . .
>
> Q Was Capella the first to invent using channel micromirrors to control channel power?

. . .

THE WITNESS: I don't recall.

. . .

Q Was Capella the first to invent using a beam deflecting element to direct light?

. . .

THE WITNESS: I just don't recall.

. . .

Q Was Capella the first to invent controlling a beam deflecting element in two dimensions?

. . .

THE WITNESS: I -- I don't recall.

. . .

Q Was Capella the first to invent ports?

A I don't recall.

Q Was Capella the first to invent collimating lenses?

. . .

THE WITNESS: I don't recall.

. . .

Q Was Capella the first to invent fiber collimators?

. . .

THE WITNESS: I don't recall.

. . .

Q Was Capella the first to invent fiber collimator ports?

A I don't recall.

. . .

Q Was Capella the first to invent continuously controlling channel micromirrors?

. . .

THE WITNESS: I -- I don't recall.

. . .

Q Was Capella the first to invent individually controlling channel micromirrors?

. . .

THE WITNESS: I don't recall.

. . .

Q Was Capella the first to invent quarter wave plates?

. . .

THE WITNESS: I don't recall.

. . .

Q Was Capella the first to invent collimator alignment mirrors?

. . .

THE WITNESS: I don't recall.

. . .

Q Was Capella the first to invent focusing lenses?

. . .

THE WITNESS: I don't recall.

. . .

Q Was Capella the first to invent a wavelength selective switch that used fiber collimator ports?

. . .

THE WITNESS: I don't recall.

. . .

Q Was Capella the first to invent a wavelength selective switch that used channel micromirrors?

. . .

THE WITNESS: I don't recall.

. . .

Q Was Capella the first to invent a wavelength selective switch that used channel micromirrors for power control?

. . .

THE WITNESS: I don't recall.

. . .

Q Was Capella the first to invent wavelength selective switch that used fiber collimator ports and channel micromirrors?

. . .

THE WITNESS: I don't recall.

. . .

Q Was Capella the first to invent a wavelength selective switch that used fiber collimator ports and used channel micromirrors for power control?

A I don't recall.

Q Was Capella the first to invent a wavelength selective switch that used fiber collimator ports and used controllable channel micromirrors?

A I don't recall.

Q Was Capella the first to invent a wavelength selective switch that used fiber collimator ports and used continuously controllable channel micromirrors?

A I don't recall.

Q Was Capella the first to invent a wavelength selective switch that used fiber collimator ports and used individually controllable channel micromirrors?

A I don't recall.

Q Was Capella the first to invent a wavelength selective switch that used fiber collimator ports and used individually and continuously controllable channel micromirrors?

A I don't recall.

Q Was Capella the first to invent a wavelength selective switch that used fiber collimator ports and used individually and continuously controllable channel micromirrors for power control?

A I don't recall.

Q Was Capella the first to invent a wavelength selective switch that used quarter wave plates?

A I don't recall.

Q Was Capella the first to invent a wavelength selective switch that used collimator alignment mirrors?

A I don't recall.

Q Was Capella the first to invent a wavelength selective switch that used focusing lenses?

A I don't recall.

Q . . . Was Capella the first to invent a reconfigurable add-drop multiplexer?

A I don't recall.

. . .

Q Was Capella the first to invent a reconfigurable add-drop multiplexer that used an auxiliary wavelength selective switch?

. . .

THE WITNESS: And I don't recall.

Id. at 94:17–101:2. Dr. Davis did recall that Capella's wavelength selective switch "made the switch completely optical," eliminating the need to "convert from optical to electrical and then back to optical":

> Q And you also referred to "a product."
>
> What was the product?
>
> A It's referred to as a wavelength selective switch.
>
> . . .
>
> Q Do you remember any details of the wavelength selective switch?
>
> A Just that it eliminated the electrical portion of switching that was the dominant method of doing switching in optical networks, and our device made the switch completely optical and you never had to convert from optical to electrical and then back to optical, as was the way it was done when we started the company.

Id. at 25:10–26:4.

> Q And why was your product a very good idea?
>
> A Because it sped up the Internet by virtue of eliminating the OEO switches and replacing them with all optical switches like our wavelength selective switch which, in turn, enabled downloading of videos for the first time in the Internet.
>
> Q Are there any other reasons why your product was a good idea?
>
> A No.

Id. at 33:5–13.

4. Testimony By Dr. Sergienko, Capella's Technical Expert

165. It is my understanding that Dr. Sergienko provided testimony as a technical expert for Capella in this case. *See* Sergienko Depo Tr. at 8:20–9:24. He acknowledged that several concepts and devices related to the Asserted Patents were already known in the prior art,

including "add-drop multiplexers," "reconfigurable add-drop multiplexers," "MEMs mirrors," and "fiber collimators":

> Q. Were add-drop multiplexers known before the Capella patents?
>
> . . .
>
> THE WITNESS: Add-drop multiplexers, I believe so. There were an array of versions of digitally switched add-drop multiplexers, cross-channel -- well, yeah, basically there were mechanical mirrors turning on and off in digital manner. I would say, yes, there were some known.
>
> Q. Were reconfigurable add-drop multiplexers known before the Capella patents?
>
> . . .
>
> THE WITNESS: Reconfigurable add-drop multiplexers, I believe they were limited to two channels, basically. That's still digital way of communication -- of switching.
>
> They are reconfigurable, but between one and two, that's all. Digital way.
>
> . . .
>
> Q. And MEMS mirrors were known before the Capella patents; correct?
>
> THE WITNESS: Yeah, the MEMS mirrors were known, and they were mainly, again, switchable in two directions -- sorry, two stage, digital way, basically the up and down. That was the main thing. The majority of other mirrors, they came later.

Id. at 186:20–188:2.

> Q. And fiber collimators were known before the Capella patents; correct?
>
> . . .
>
> THE WITNESS: The fiber collimators is known in the field in the art for relatively long time. In fact, fiber collimator or light collimator, it doesn't really matter. So you just have -- if you want to have a pencil-like beam, you need to have a collimator. That's a basic principle.

> . . .
>
> Q. And fiber collimator ports were known before the Capella patents; correct?
>
> . . .
>
> THE WITNESS: I am not sure. I don't remember seeing someone was talking about this before Capella, but if you're making a device that's supposed to work with like wavelength selective switch, you would need to use the fiber collimator to create a pencil-like beam inside.

Id. at 190:2–23.

166. During his depositions in the previous *inter partes* review proceedings in 2015 (over five years closer to the priority date of the Asserted Patents), Dr. Sergienko acknowledged that other concepts and devices were already known in the prior art, including (1) "two axis mirrors"; (2) "ROADMs"; (3) "power control by using angular misalignment"; (4) "power control by using lateral misalignment"; (5) "ruled diffraction gratings"; (6) "holographic diffraction gratings"; (7) "echelette gratings"; (8) "curved diffraction ratings"; and (9) "dispersing prisms":

> Q And people of ordinary skill understood that there were two axis mirrors in the prior art before the filing of the Capella patents, right?
>
> . . .
>
> A Yes, there were two-dimensional mirrors of different kinds, different designs. Some more successful, some less successful.

Cisco Sys., Inc. v. Capella Photonics, Inc., Case IPR2014-01166, Patent RE42,368, Sergienko Depo. Tr. at 189:19–190:2 (June 30, 2015).

> Q . . . ROADMs were known before the Capella patents, correct?
>
> A Correct.
>
> Q Two-axis MEMS mirrors were known?

A That's correct.

Q Power control by using angular misalignment?

A Yes.

Q Power control by using lateral misalignment?

A Yes.

Q Ruled diffraction gratings . . . .

A Yes, yes.

Q Holographic diffraction gratings?

A Yes.

Q Echelette gratings?

A Yes.

Q Curved diffraction gratings?

A Yes.

Q Dispersing prisms?

A Yes.

Id. at 268:2–269:7.

IX. OBVIOUSNESS

167. As set forth above, it is my opinion that all of the subject matter claimed in the Asserted Claims was well known and disclosed in the prior art at the time of the alleged invention. It is my opinion that the Asserted Claims are invalid as being obvious in view of the prior art discussed throughout the sections below. The bases for my opinions regarding obviousness are detailed in this section. I have based my opinions on the Parties' proposed claim constructions and my understanding of the claims from the perspective of one of ordinary skill in the art.

168. I understand that the obviousness analysis is based on four factual inquiries (the *Graham* factors): (1) the level of ordinary skill in the art; (2) the scope and content of the prior art; (3) the differences between the prior art and the claimed invention; and (4) any secondary indicia of obviousness. As set forth above in Section III.D.1.d (Paragraphs 55-60), I understand there are several rationales for determining obviousness based on the consideration of these four factors.

169. My analysis regarding the level of ordinary skill in the art is set forth above in Section VI (Paragraphs 70-74). My analysis regarding the remaining factors and my opinion that the claims are obviousness is set forth below.

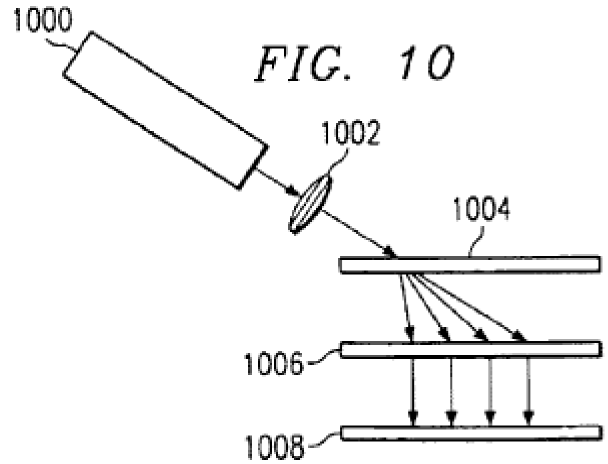
1. The Scope and Content of the Prior Art

170. As explained above, the Technical Background section of my report (Section VII (Paragraphs 75-138)) and the section discussing characterizations of the Asserted Patents (Section VIII (Paragraphs 139-166)) describe technology and concepts that were both in the prior art and was well-known before the time of invention of the Asserted Patents. I incorporate those sections by reference. The following analysis provides my opinions regarding the scope and content of specific prior art references.

a) U.S. Patent No. 6,816,640 ("Tew '640")

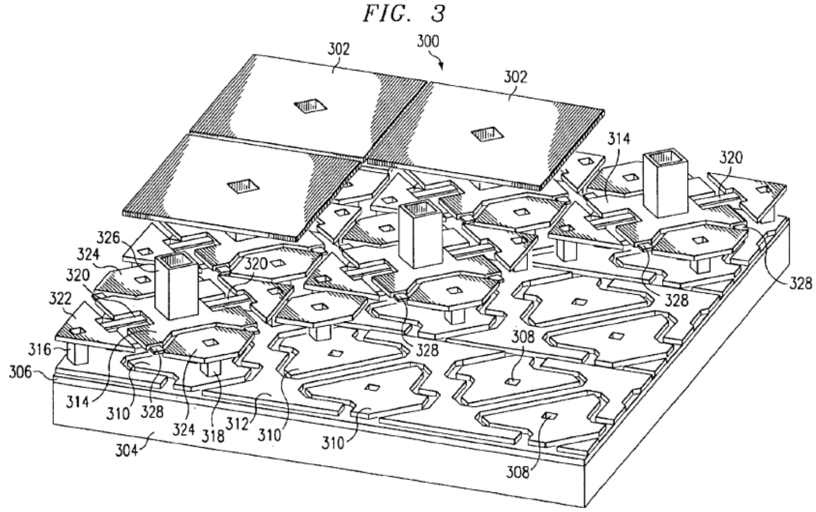
171. Tew '640 is directed to "an optical switch ideally suited for use as an optical add drop multiplexer (OADM)." Tew '640 at Abstract; *see also* Provisional Application No. 60/236,532 at Abstract.

172. As shown in Figure 10, reprinted below, light from the input fiber (reference numeral 1000) is collimated by a optic (reference numeral 1002), separated by a beam separator (reference numeral 1004), and focused ~~by~~ a focusing optic (reference numeral 1006) onto a mirror array (reference numeral 1008).



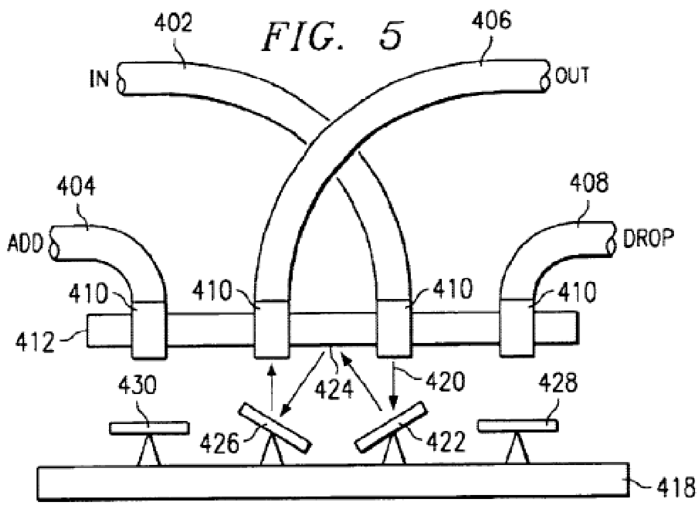
Tew ’640 at FIG. 10; *see also id.* at 10:35-43; Provisional Application No. 60/236,532 at FIG. 10, 19:18-23. After, the mirror array (as shown in Figure 1, reprinted below) can selectively direct the beams to one of at least two output fibers. Tew ’640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23.

FIG. 3



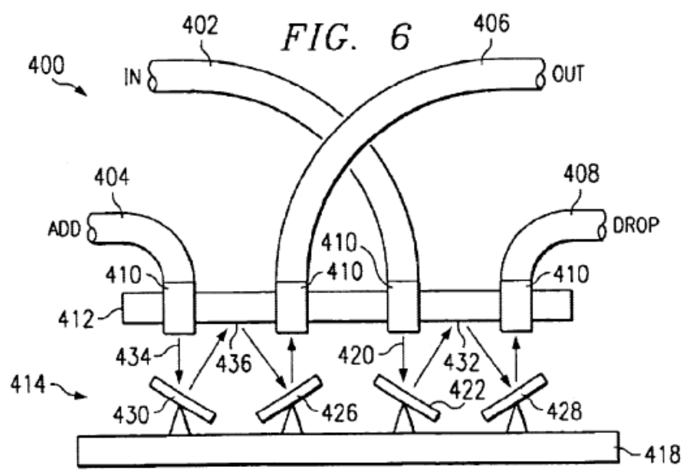
Tew ’640 at FIG. 3; *see also* Provisional Application No. 60/236,532 at FIG. 3. As shown in Figures 5 and 6, reprinted below, each mirror (reference numerals 422, 426, 428, 430) can rotate to reflect light from an input fiber (reference numeral 402) or add fiber (reference numeral 404) to an output fiber (reference numeral 406) or drop fiber (reference numeral 408).

FIG. 5



Tew ’640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.

FIG. 6



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.

(i) Tew ’640 *Is Prior Art to the Asserted Claims*

173. Tew ’640 claims priority to Provisional Application No. 60/236,532 filed on September 29, 2000 and Provisional Application No. 60/236,532 filed on September 29, 2000 and Provisional Application No. 60/236,677 filed on September 29, 2000, was filed on September 28, 2001, was published as 2002/0044722 on April 18, 2002, and issued on November 9, 2004.

174. As noted above in Section III.D.1.a (Paragraph 47), it is my understanding that for a patent or patent publication to claim priority to a provisional application, the provisional application must contain, for at least one claim recited in the patent or published patent application, a written description of the invention and the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable a person of ordinary skill in the art to practice the claimed invention. It is my opinion that these requirements are satisfied for Tew ’640 with respect to Provisional Application No. 60/236,532. Accordingly, it is my understanding that Tew ’640 is entitled to a priority date of September 29, 2000.

175. I understand that Tew ’640 is entitled to the priority date of Provisional Application No. 60/236,532 if at least one claim in Tew ’640 is supported by the disclosure of Provisional Application No. 60/236,532. At least Claim 1 of Tew ’640 is supported by the disclosure of Provisional Application No. 60/236,532. With respect to the preamble, which sets forth “[a]n optical switch comprising,” Provisional Application No. 60/236,532 discloses “[a]n optical switch ideally suited for use as an optical add drop multiplexer (OADM).” *See* Provisional Application No. 60/236,532at Abstract; *see also id.* at 3:4-5, FIG. 2.

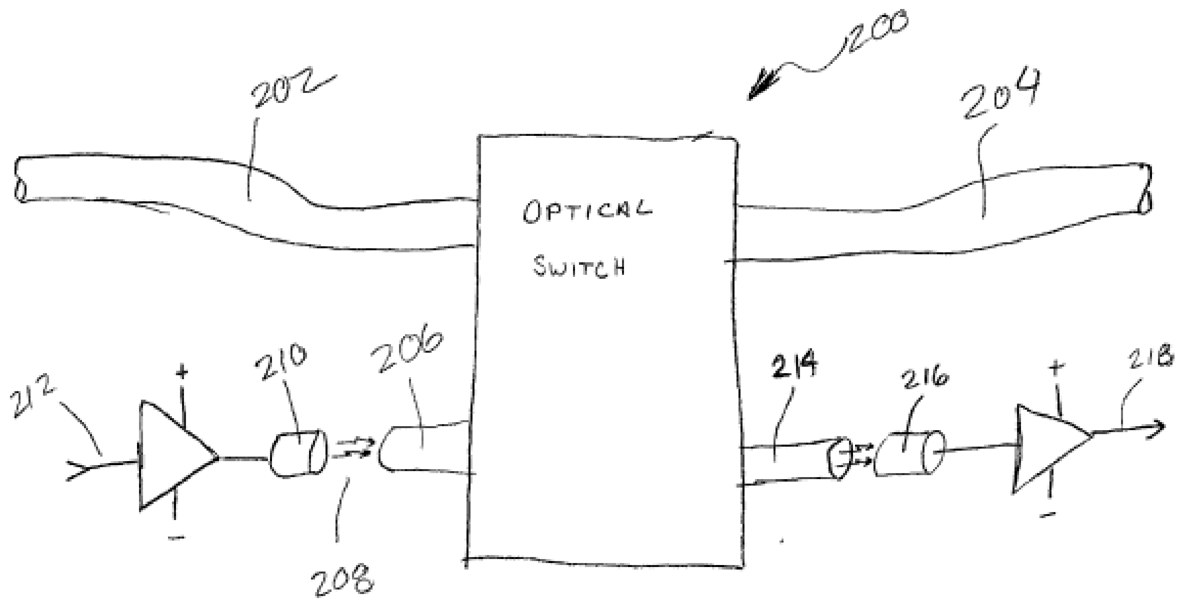


FIG. 2

176. With respect to "a first input operable to provide a first input optical signal," Provisional Application No. 60/236,532 discloses "[t]he optical comprises: ***a first input operable to provide a first input optical signal***, a second input operable to provide a second input optical signal, a first output, operable to transmit either of the first and second signals, a second output operable to transmit the first signal; a retro-reflector, and a first, second, third, and fourth deflector." *See* Provisional Application No. 60/236,532 at 3:5-9 (emphasis added); *see also id.* at FIGS. 4-9 (FIG. 4 reproduced below).

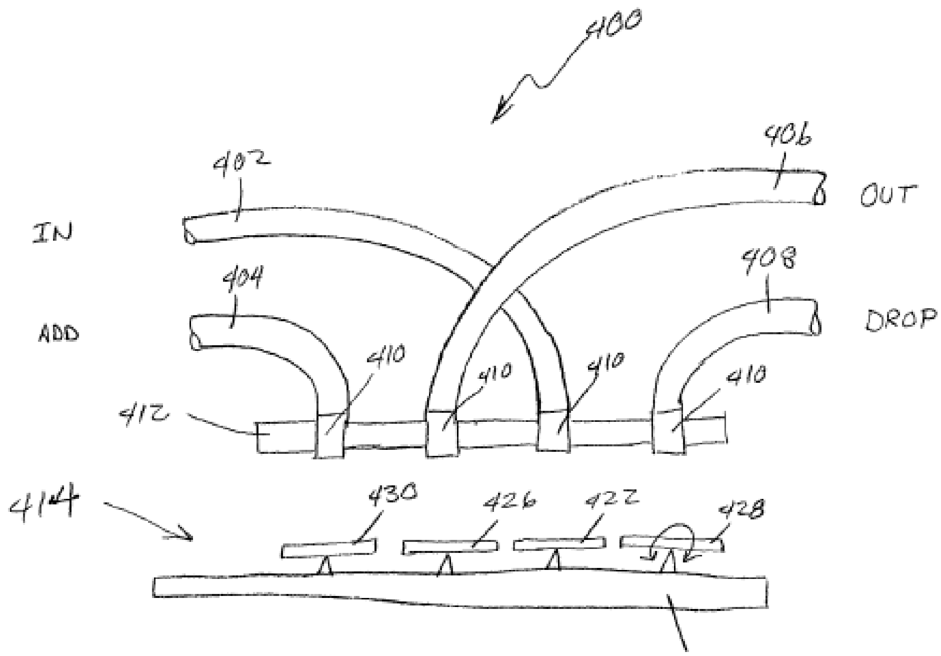


FIG. 4

177. With respect to "a second input operable to provide a second input optical signal," Provisional Application No. 60/236,532 discloses "[t]he optical comprises: a first input operable to provide a first input optical signal, ***a second input operable to provide a second input optical signal***, a first output, operable to transmit either of the first and second signals, a second output operable to transmit the first signal; a retro-reflector, and a first, second, third, and fourth deflector." *See* Provisional Application No. 60/236,532 at 3:5-9 (emphasis added); *see also id.* at FIGS. 4-9 (FIG. 4 reproduced below).

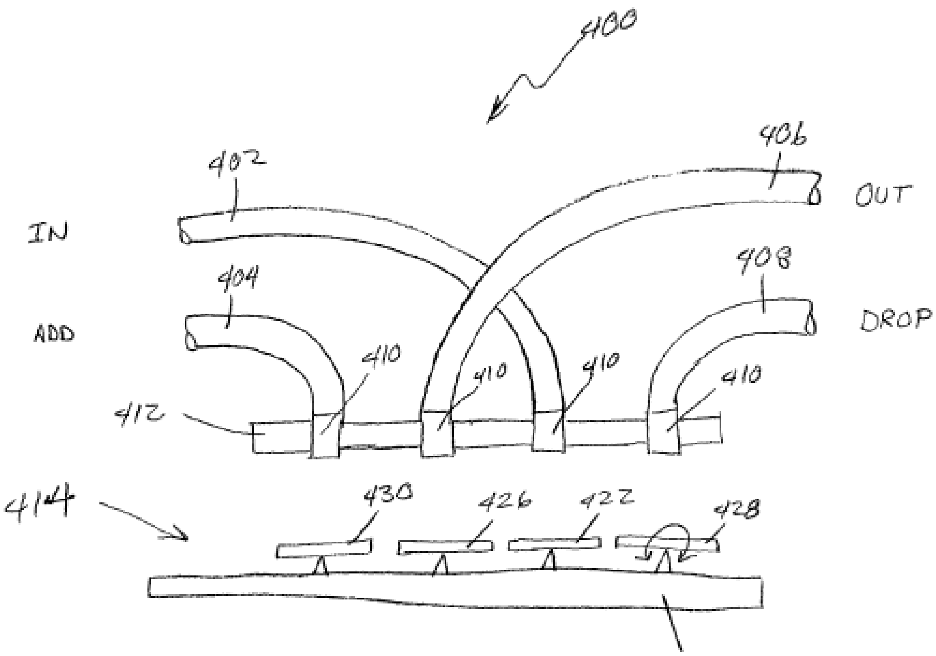


FIG. 4

178. With respect to "a first output operable to transmit either of said first and second signals," Provisional Application No. 60/236,532 discloses "[t]he optical comprises: a first input operable to provide a first input optical signal, a second input operable to provide a second input optical signal, ***a first output, operable to transmit either of the first and second signals***, a second output operable to transmit the first signal; a retro-reflector, and a first, second, third, and fourth deflector." *See* Provisional Application No. 60/236,532 at 3:5-9 (emphasis added); *see also id.* at FIGS. 4-9 (FIGS. 5-6 reproduced below).

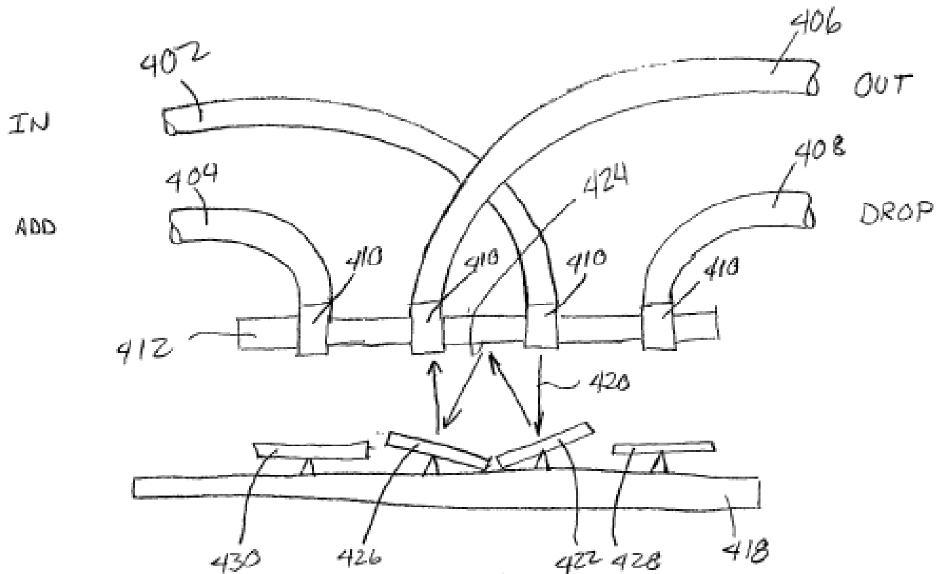


FIG. 5

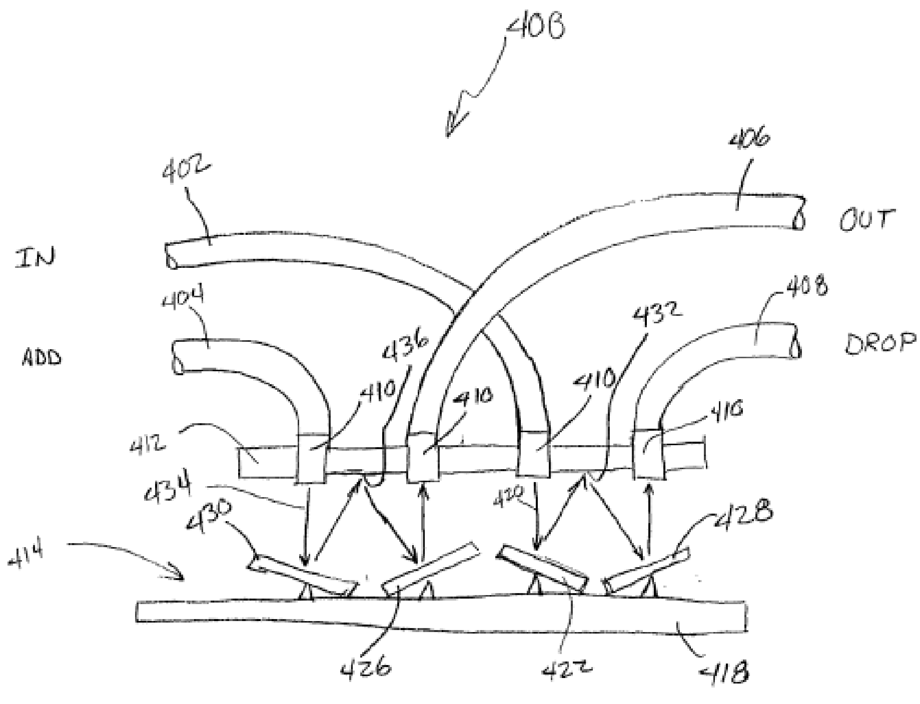


FIG. 6

179. With respect to "a second output operable to transmit said first signal," Provisional Application No. 60/236,532 discloses "[t]he optical comprises: a first input operable to provide a first input optical signal, a second input operable to provide a second input optical

signal, a first output, operable to transmit either of the first and second signals, ***a second output operable to transmit the first signal***; a retro-reflector, and a first, second, third, and fourth deflector." *See* Provisional Application No. 60/236,532 at 3:5-9 (emphasis added); *see also id.* at FIGS. 4-9 (FIG. 6 reproduced below).

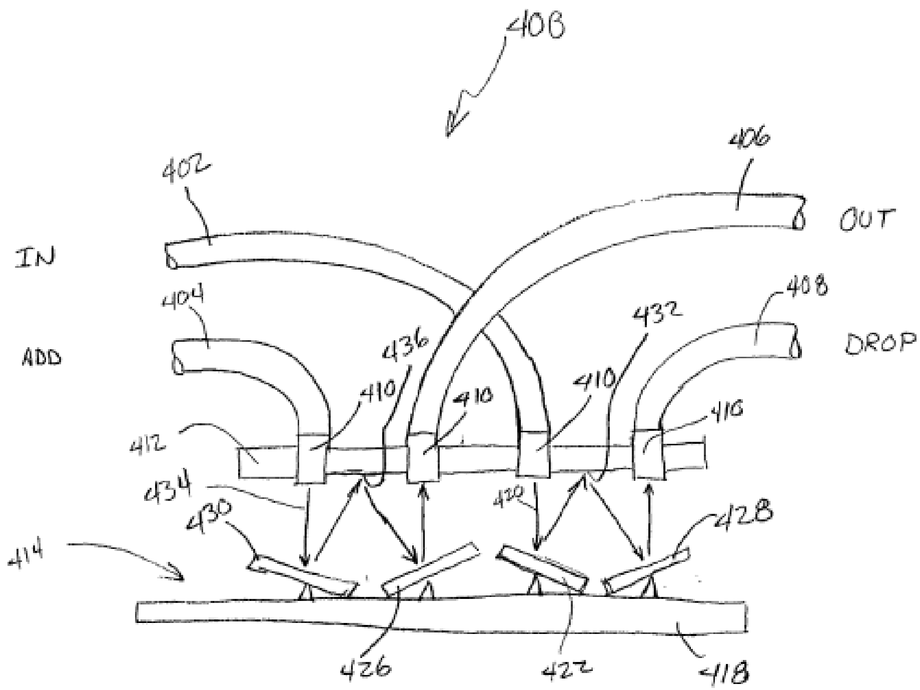


FIG. 6

180. With respect to "a retro-reflector," Provisional Application No. 60/236,532 discloses "[t]he optical comprises: a first input operable to provide a first input optical signal, a second input operable to provide a second input optical signal, a first output, operable to transmit either of the first and second signals, a second output operable to transmit the first signal; ***a retro-reflector***, and a first, second, third, and fourth deflector." *See* Provisional Application No. 60/236,532 at 3:5-9 (emphasis added); *see also id.* at 17:7-10 ("Figure 7 is a side view of the OADM of Figure 4 showing a retro-reflector 438 that is separate from the holder block 412. The retro-reflector 438 is a single reflector, or separate reflectors in each of the regions used to reflect the light signals. The retro-reflector typically is flat, but may be

curved, typically concave, to focus the light beam while it is being reflected."), FIGS. 4-9 (FIG. 7 reproduced below).

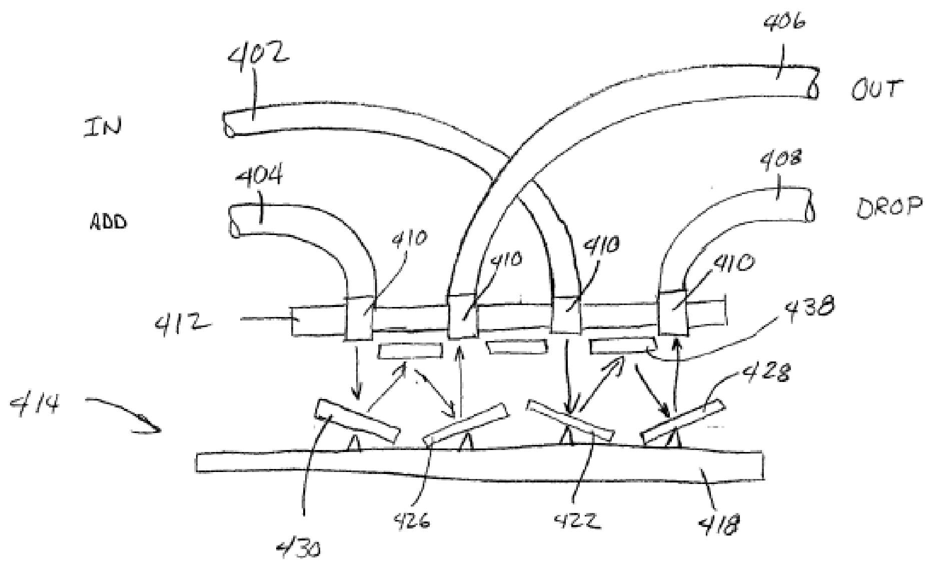


FIG. 7

181. With respect to "a first deflector operable to rotate about an axis in opposite directions from a neutral position to a first and second state, said first deflector operable in said first state to direct said first input optical signal from said first input to a first point on said retro-reflector, said first deflector operable in said second state to direct said first input optical signal to a second point on said retro-reflector," Provisional Application No. 60/236,532 discloses "[t]he optical comprises: a first input operable to provide a first input optical signal, a second input operable to provide a second input optical signal, a first output, operable to transmit either of the first and second signals, a second output operable to transmit the first signal; a retro-reflector, and a ***first***, second, third, and fourth ***deflector***." *See* Provisional Application No. 60/236,532 at 3:5-9 (emphasis added). Provisional Application No. 60/236,532 further discloses "[t]he first deflector is operable in a first state to direct the first input optical signal from the first input to a first point on the retro-reflector. The first deflector is operable in a second state to

direct the first input optical signal to a second point on the retro-reflector." *See* Provisional Application No. 60/236,532 at 3:9-11; *see also id.* at FIGS. 4-9 (FIGS. 5-6 reproduced below).

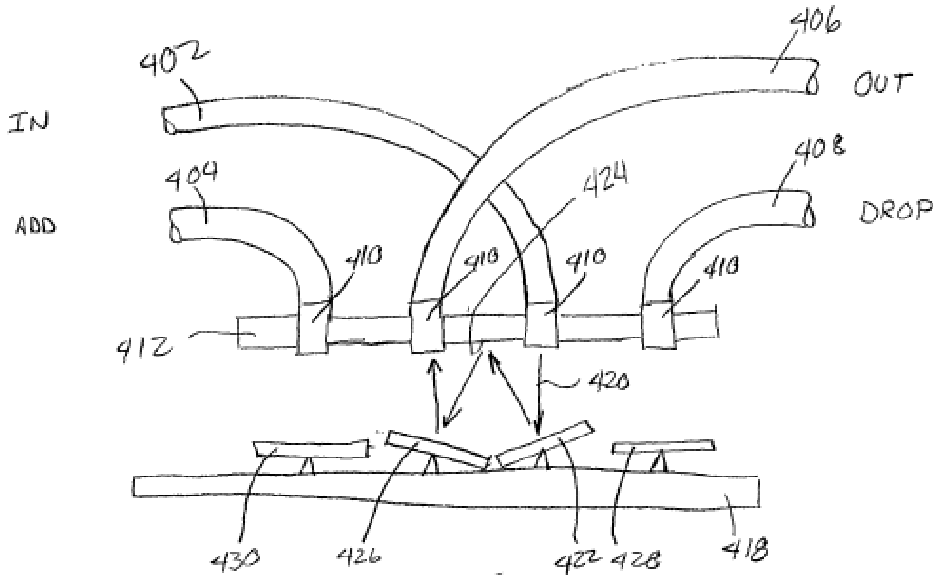


FIG. 5

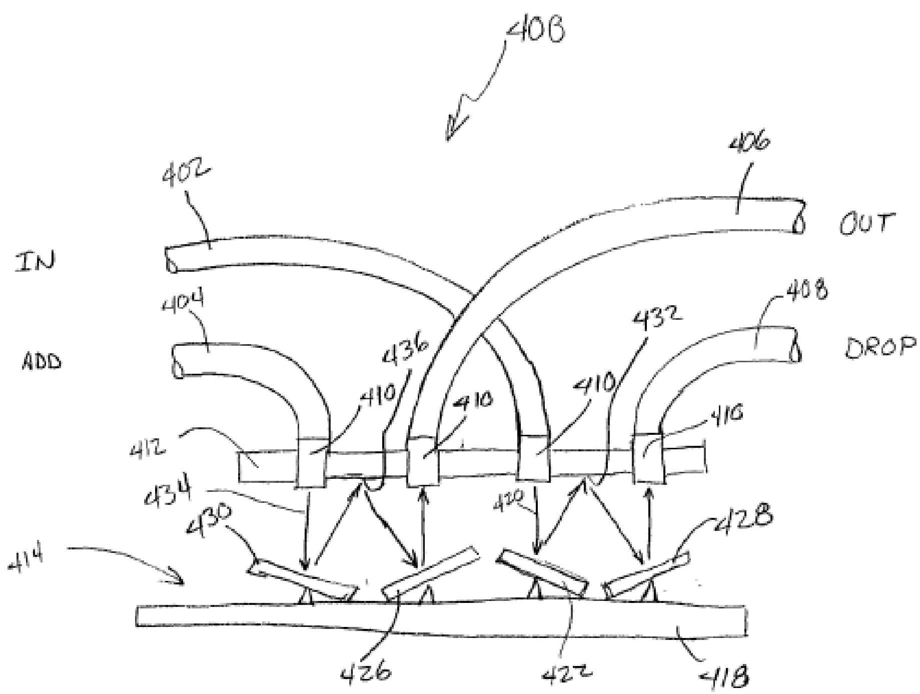


FIG. 6

182. With respect to "a second deflector operable to direct said first input optical signal from said second point of said retro-reflector to said second output," Provisional Application No. 60/236,532 discloses "[t]he optical comprises: a first input operable to provide a first input optical signal, a second input operable to provide a second input optical signal, a first output, operable to transmit either of the first and second signals, a second output operable to transmit the first signal; a retro-reflector, and a first, ***second***, third, and fourth ***deflector***." *See* Provisional Application No. 60/236,532 at 3:5-9 (emphasis added); *see also id.* at FIGS. 4-9. Provisional Application No. 60/236,532 further discloses "[t]he second deflector is operable to direct the first input optical signal from the second point of the retro-reflector to the second output." *See* Provisional Application No. 60/236,532 at 3:11-13; *see also id.* at FIGS. 4-9 (FIG. 6 reproduced below).

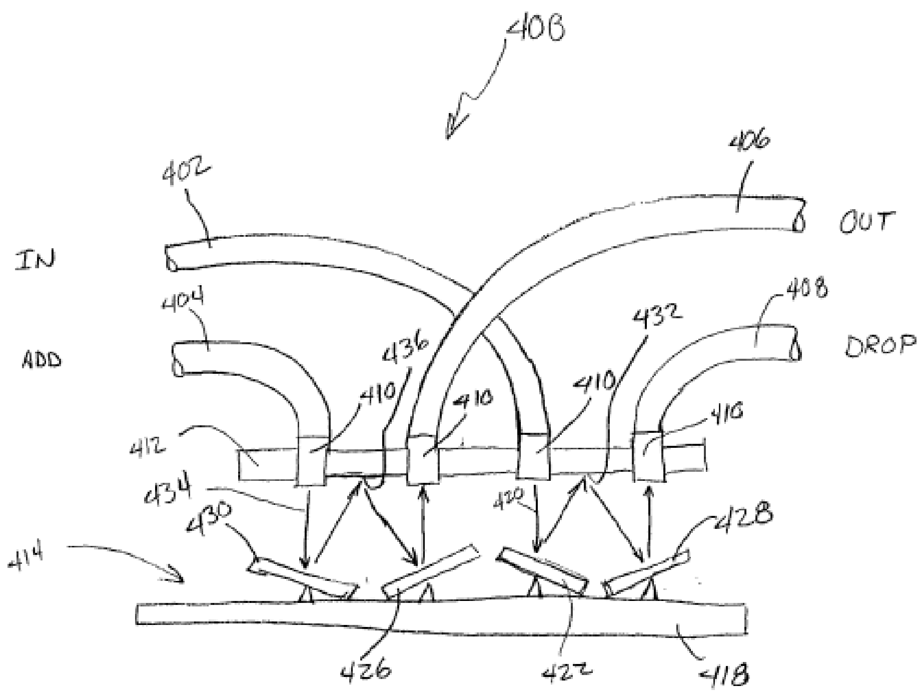


FIG. 6

183. With respect to "a third deflector operable to direct said second input optical signal from said second input to a third point on said retro-reflector," Provisional Application

No. 60/236,532 discloses "[t]he optical comprises: a first input operable to provide a first input optical signal, a second input operable to provide a second input optical signal, a first output, operable to transmit either of the first and second signals, a second output operable to transmit the first signal; a retro-reflector, and a first, second, ***third***, and fourth ***deflector***." *See* Provisional Application No. 60/236,532 at 3:5-9 (emphasis added). Provisional Application No. 60/236,532 further discloses "[t]he third deflector is operable to direct the second input optical signal from the second input to a third point on the retro-reflector." *See* Provisional Application No. 60/236,532 at 3:13-14; *see also id.* at FIGS. 4-9 (FIG. 6 reproduced below).

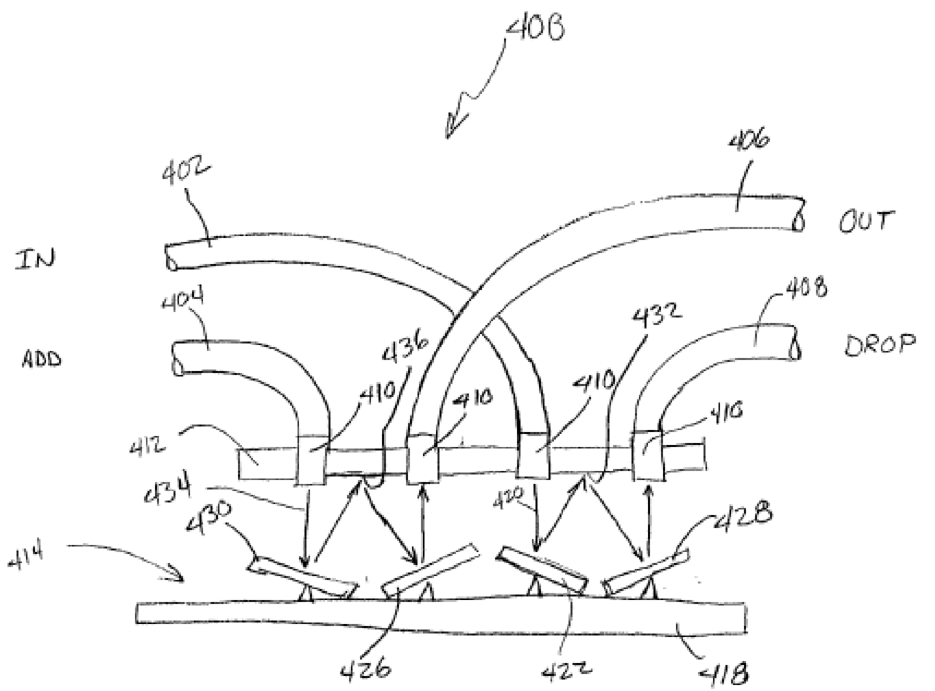


FIG. 6

184. With respect to "a fourth deflector operable to rotate about an axis in opposite directions from a neutral position to a first and second state, said fourth deflector operable in said first state to direct said first optical input signal from said first point on said retro-reflector to said first output, said fourth deflector operable in said second state to direct said second input optical signal from said third point on said retro-reflector to said first output," Provisional

Application No. 60/236,532 discloses "[t]he optical comprises: a first input operable to provide a first input optical signal, a second input operable to provide a second input optical signal, a first output, operable to transmit either of the first and second signals, a second output operable to transmit the first signal; a retro-reflector, and a first, second, third, and ***fourth deflector***." *See* Provisional Application No. 60/236,532 at 3:5-9 (emphasis added). Provisional Application No. 60/236,532 further discloses "[t]he fourth deflector is operable in a first state to direct the first optical input signal from the first point on the retro-reflector to the first output. The fourth deflector is operable in a second state to direct the second input optical signal from the third point on the retro-reflector to the first output." *See* Provisional Application No. 60/236,532 at 3:14-17; *see also id.* at FIGS. 4-9 (FIGS. 5-6 reproduced below).

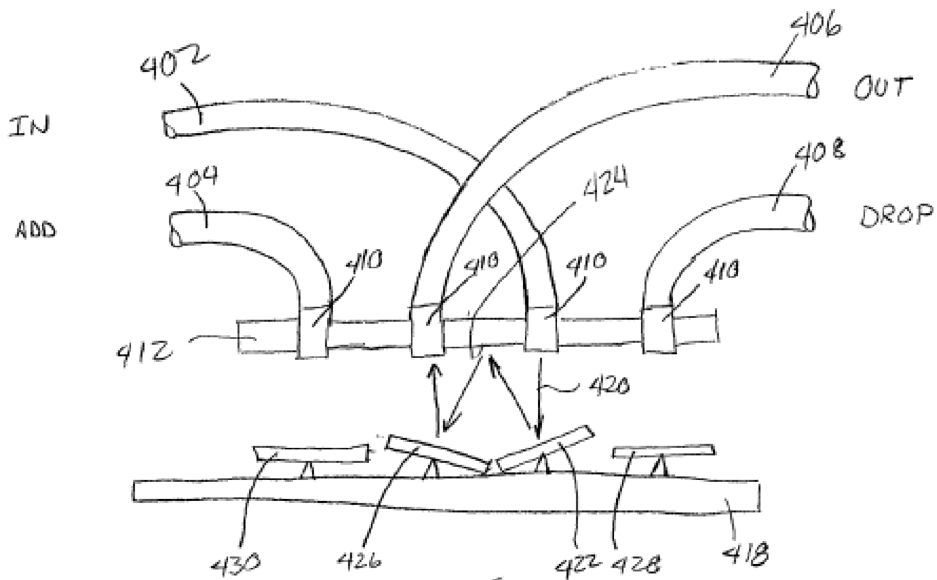


FIG. 5

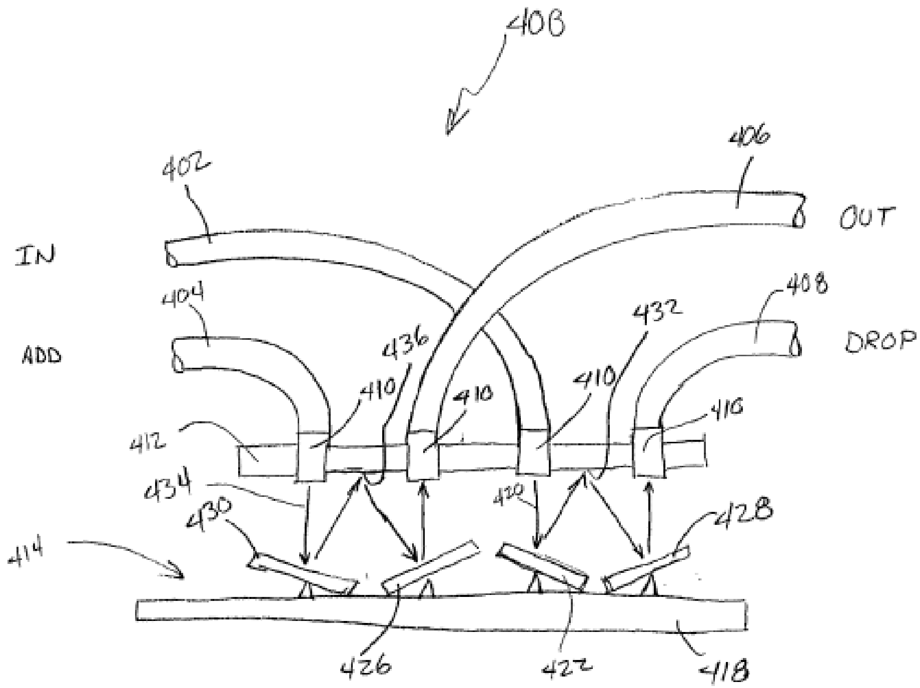


FIG. 6

185. Accordingly, it is my understanding that Tew '640 is prior art to the '905 and '906 Patents under at least pre-AIA 35 U.S.C. § 102(e).

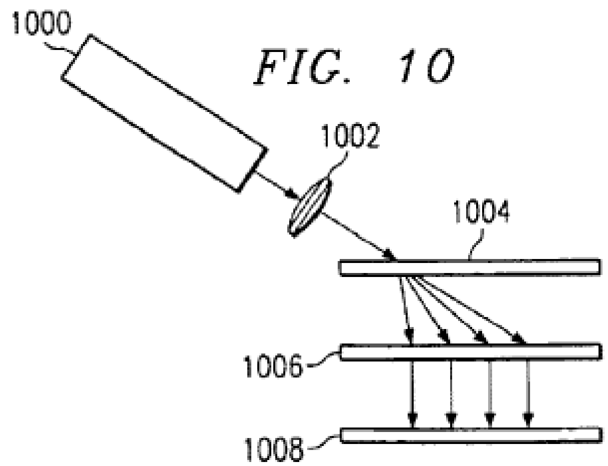
(ii) *'905 Patent, [23-pre]: "An optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports, the apparatus comprising"*

186. To the extent the language in the preamble is considered limiting, Tew '640 discloses to a POSITA "an optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports."

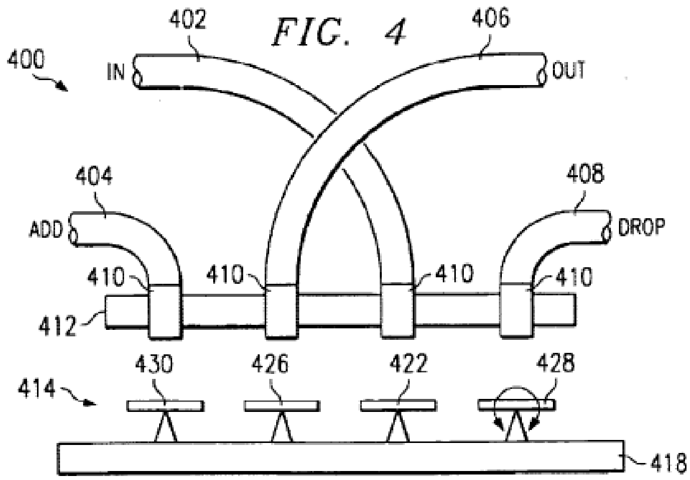
187. Tew '640 discloses an output fiber to receive a signal. For example, "a first output [is] operable to transmit either of the first and second signals, a second output operable to transmit the first signal." Tew '640 at 2:20-26; *see also id.* at Abstract; Provisional Application No. 60/236,532 at 3:18-22, Abstract.

188. Tew '640 discloses a signal from an input fiber being collimated. For example, in "FIG. 10, light from an input fiber 1000 is collimated by an optic 1002 and strikes a beam

separator such as diffraction grating 1004." Tew '640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23.



Tew '640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10. Tew '640 discloses having a first input fiber providing a signal and a second input fiber (such as the "add" fiber to provide an additional signal), and a first output fiber to receive the signal and a second output fiber (such as the "drop" fiber to drop a signal). For example, in "FIG. 4, the OADM 400 has two inputs and two outputs. A first input fiber 402 provides an optical signal to the OADM 400. This first input fiber 402, the "in" fiber, typically provides signals from remote portions of an optical network. A second input 404, the "add" fiber, allows a local signal to be transmitted by the network. The two output fibers include a first output 406, typically connected to the rest of the network, and a second output 408, typically used to deliver a signal to local equipment." Tew '640 at 8:14-22; *see also* Provisional Application No. 60/236,532 at 15:12-17.



Tew ’640 at FIG. 4; *see also* Provisional Application No. 60/236,532 at FIG. 4. To the extent that “fiber collimator” port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a “fiber collimator” port in a single package.

189. Therefore, under Capella’s apparent interpretation, Tew ’640 discloses to a POSITA “An optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

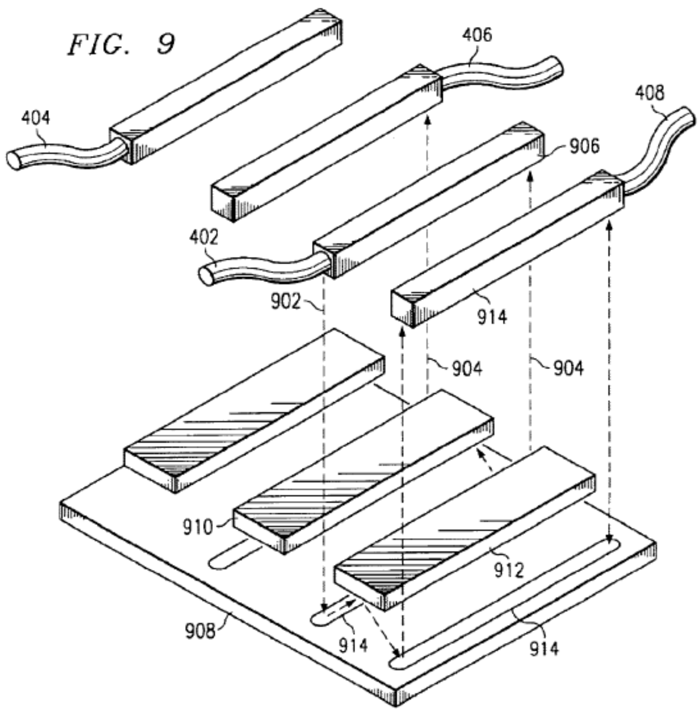
(iii) *’905 Patent, [23-a] “the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels”*

190. Under Capella’s apparent interpretation, Tew ’640 discloses to a POSITA “the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels.”

191. Tew ’640 discloses an optical add drop multiplexer (OADM) that can separate a light beam by wavelength to yield multiple light beams that can be received by different output

ports. For example, "a light beam entering the OADM through a first input fiber 402 is separated by wavelength to yield two light beams 902, 904. The number of separate light beams output by the wavelength separator 906 is not critical, but is determined by the capability of the splitter to separate the wavelengths and by the ability of the remainder of the optical network to generate the various wavelengths." Tew '640 at 9:49-60; *see also id.* at 10:5-8; Provisional Application No. 60/236,532 at 18:8-14, 18:22-19:1.

FIG. 9



Tew '640 at FIG. 9; *see also* Provisional Application No. 60/236,532 at FIG. 9. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

192. Therefore, under Capella's apparent interpretation, Tew '640 discloses to a POSITA "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels." Even if Tew '640 does not do so, however, these limitations would have

been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(iv) *'905 Patent, [23-b] "the fiber collimator one or more other ports for second spectral channels"*

193. Under Capella's apparent interpretation, Tew '640 discloses to a POSITA "the fiber collimator one or more other ports for second spectral channels."

194. Tew '640 discloses light from an input fiber being collimated before striking a beam separator, directed to a focusing optic, and then directed to a mirror array. Collimating light from the one or more other fibers for the second spectral channels can come from the second input fiber, which can be the add fiber. For example, "light from an input fiber 1000 is collimated by an optic 1002." Tew '640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23. The input can be a second input, such as the "add" fiber. For example, A second input 404, the "add" fiber, allows a local signal to be transmitted by the network." Tew '640 at 8:14-22; *see also* Provisional Application No. 60/236,532 at 15:12-17.

195. Additionally, components such as fiber collimators can be added to different portions of the embodiments, as would suit the optical designer. For example, "focusing optics may be added between the input fibers and the wavelength separators, between the wavelength combiners 914 and the output fibers, and between the mirror array 908 and separators 906 or combiners 914. Furthermore, although shown as separate separators 906 and combiners 914, it should be understood that other configurations are intended by this disclosure." Tew '640 at 10:21-34; *see also* Provisional Application No. 60/236,532 at 19:9-17.

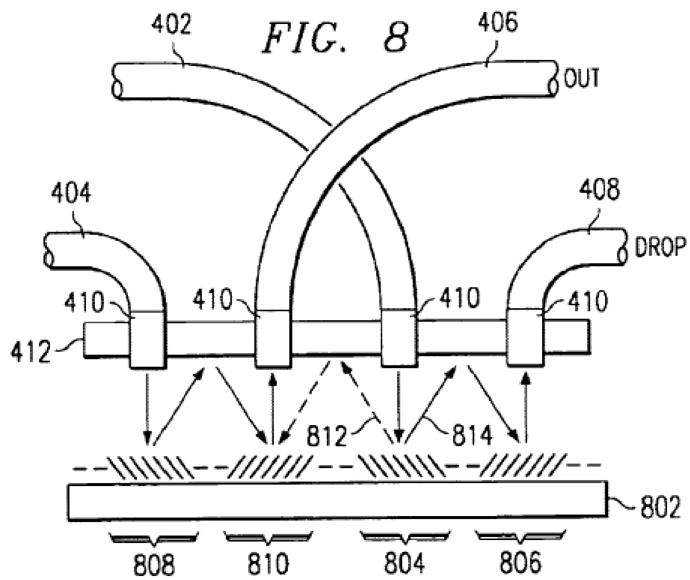
196. Therefore, under Capella's apparent interpretation, Tew '640 discloses to a POSITA "the fiber collimator one or more other ports for second spectral channels." Even if Tew '640 does not do so, however, these limitations would have been within the common

knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(v) *'905 Patent, [23-c] "the output port for an output multi-wavelength optical signal"*

197. Tew '640 discloses to a POSITA "the output port for an output multi-wavelength optical signal."

198. Tew '640 discloses combining multiple wavelengths into an output. For example, "when light beam 902 is reflected by the second region 912 of the retro-reflector, it again travels to the mirror array 908 and is then reflected to a wavelength combiner 914 and output on the second ("drop") output fiber 408." Tew '640 at 9:67-10:4; *see also id.* at Abstract; Provisional Application No. 60/236,532 at 18:19-21, Abstract. Figure 8 of Tew '640, reprinted below, shows that light from an input fiber (reference number 402) can be reflected to an output fiber (reference number 410), and light from an add fiber (reference number 404) can also be reflected to the output fiber (reference number 410), thus combining the multiple wavelengths into an output signal. For example, when "light from a first input fiber 402 is deflected by a first deflector, typically a group 804 of micromirrors. When the deflector 804 is in a first position, the input light is directed along a first path 812 to a fourth deflector 810 and then to a first output fiber 406. When the deflector 804 is in a second position, the input light is directed along a second path 814 to a second deflector 806 and from the second deflector 806 to a second output 408. Light from a second input 404 is directed by deflector 808 along a path to the fourth deflector 810 and from there to the first output 406." Tew '640 at 9:67-10:4; *see also* Provisional Application No. 60/236,532 at 18:19-21.



Tew '640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

199. Therefore, Tew '640 discloses to a POSITA "the output port for an output multi-wavelength optical signal." Even if Tew '640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(vi) *'905 Patent, [23-d] "a wavelength-selective device for spatially separating said spectral channels"*

200. Tew '640 discloses to a POSITA "a wavelength-selective device for spatially separating said spectral channels."

201. Tew '640 discloses a beam separator that can separate light from an input fiber into multiple separated beams of light. For example, In Figure 10, reprinted below, "light from an input fiber 1000 is collimated by an optic 1002 and strikes a beam separator such as diffraction grating 1004. The diffraction grating spatially separates the component beams of the input light beam" (emphasis added). Tew '640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23.

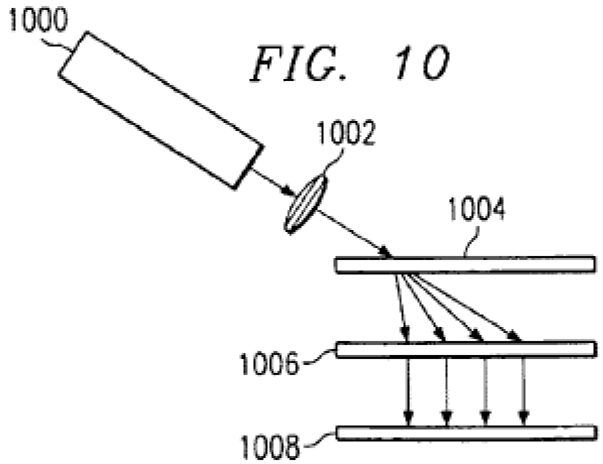


FIG. 10

Tew '640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10. Additionally, in Figure 11, reprinted below, the light separated from by the beam separator (diffraction grating 1004) can be individually captured by a number of fibers. For example, "[t]he separated beams are then individually captured by a set of optical fibers 1010. The optical fibers 1010 re-emit the separated light beams to the mirror array 1008." Tew '640 at 10:44-50; *see also* Provisional Application No. 60/236,532 at 20:1-5.

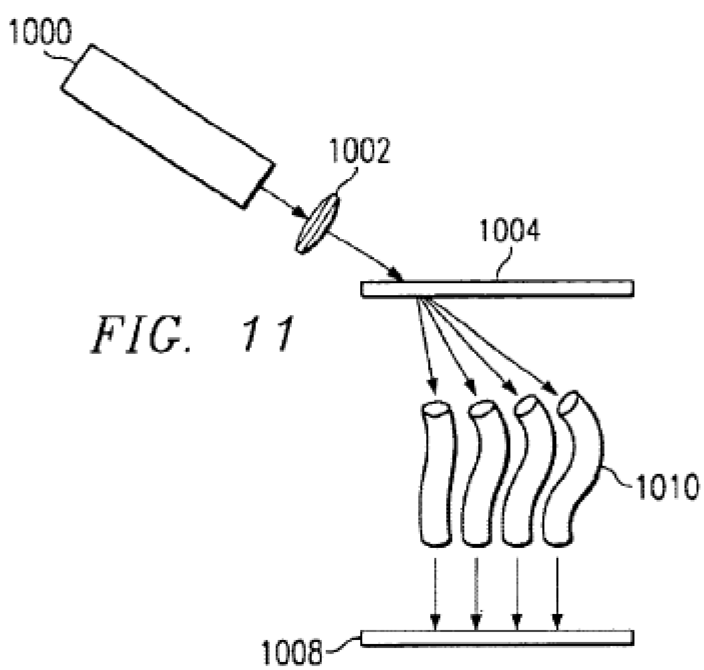


FIG. 11

Tew '640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11.

202. Therefore, Tew ’640 discloses to a POSITA “a wavelength-selective device for spatially separating said spectral channels.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(vii) *’905 Patent, [23-e] “a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port”*

203. Tew ’640 discloses “a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being … continuously controllable … to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports.” To the extent Tew ’640 not teach “each of said elements being individually … controllable in two dimensions … and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]” these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

204. Tew ’640 discloses to a POSITA “a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels.”

205. For example, the separated light beams are emitted to a mirror array. As shown in Figure 10, reprinted below, the separated beams are then individually captured by a set of optical fibers 1010. The optical fibers 1010 re-emit the separated light beams to the mirror array 1008.” Tew ’640 at 10:44-50; *see also* Provisional Application No. 60/236,532 at 20:1-5.

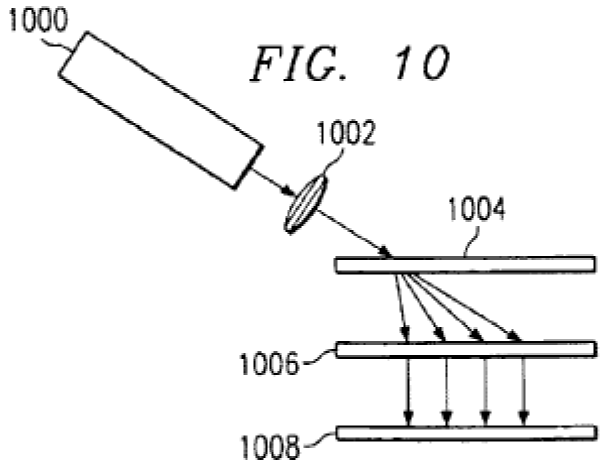


FIG. 10

Tew ’640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10. Figure 11, reprinted below, also shows light from an input fiber being separated and then emitted to a mirror array. “[L]ight from the input fiber 1000 again is focused onto a beam separator such as diffraction grating 1004 by a focusing optic 1002. The separated beams are then individually captured by a set of optical fibers 1010. The optical fibers 1010 re-emit the separated light beams to the mirror array 1008.” Tew ’640 at 10:44-50; *see also* Provisional Application No. 60/236,532 at 20:1-5.

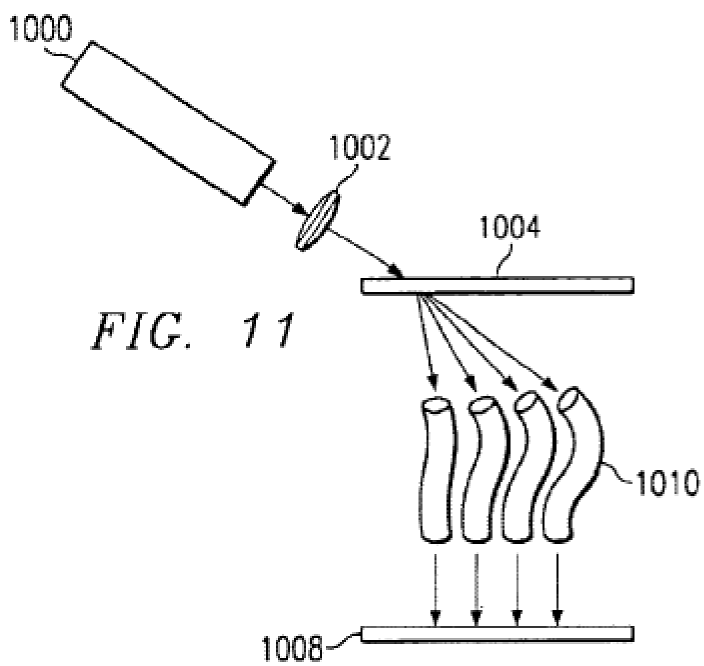
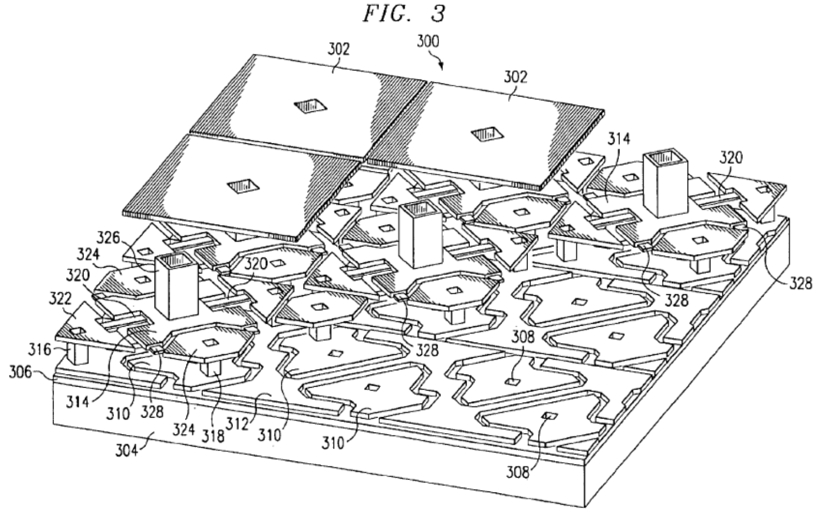


FIG. 11

206. Tew '640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11. Tew '640 describes the beam-deflecting element(s) as being an array of mirrors such as a "micromirror device … The micromirror used in the OADM operates using electromagnetic, electrostatic, piezoelectric, or other force. The micro mirror is an array of mirrors fabricated on a common substrate, or an array of mirrors separately fabricated and assembled into the OADM. The mirrors are silicon, gold, aluminum, or other metals or materials capable of reflecting the signal energy in the wavelengths transmitted by the switch. If the mirrors are sufficiently large, a single mirror is used to reflect each signal. Alternatively, a number of small mirrors are used to collectively reflect … each signal." Tew '640 at 5:19-32; *see also* Provisional Application No. 60/236,532 at 10:3-11. As shown in Figure 3, reprinted below, the an array of micromirrors can be formed on a silicon substrate. "The silicon substrate 304 and any necessary metal interconnection layers are isolated from the micromirror superstructure by an insulating layer 306 which is typically a deposited silicon dioxide layer on which the micromirror superstructure is formed. Holes, or vias, are opened in the oxide layer to allow electrical connection of the micromirror superstructure with the electronic circuitry formed in the substrate 304." Tew '640 at 6:5-12; *see also* Provisional Application No. 60/236,532 at 11:14-18.

FIG. 3



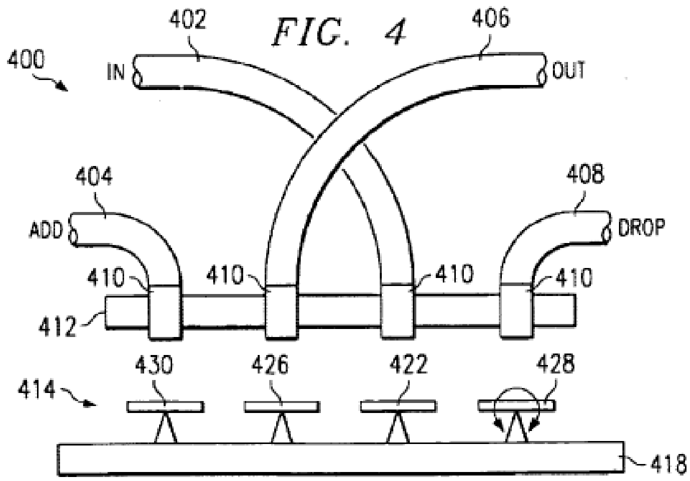
Tew ’640 at FIG. 3; *see also* Provisional Application No. 60/236,532 at FIG. 3.

207. Tew ’640 discloses to a POSITA “each of said elements being … continuously controllable … to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports.”

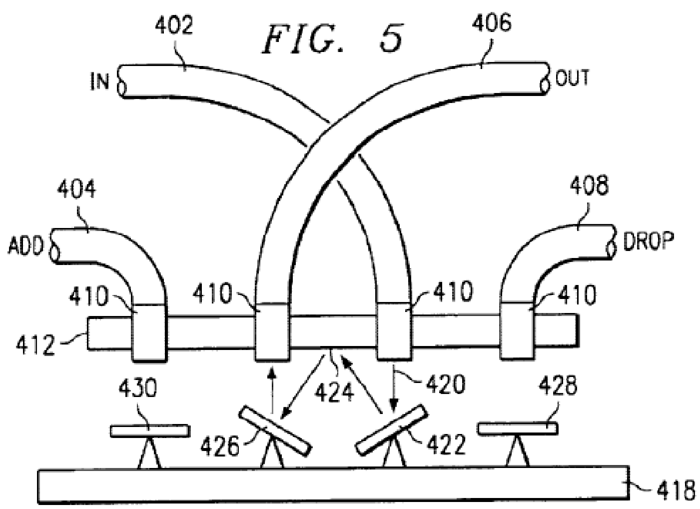
208. Tew ’640 discloses the micromirrors being operated in an analog mode, which is sometimes called beam steering. “Micromirror devices are generally operated in one of two modes of operation. The first mode of operation is an analog mode, sometimes called beam steering, in which the address electrode is charged to a voltage corresponding to the desired deflection of the mirror. Light striking the micromirror device is reflected by the mirror at an angle determined by the deflection of the mirror.” Tew ’640 at 7:53-59; *see also* Provisional Application No. 60/236,532 at 14:16-20.

209. Tew ’640 discloses to a POSITA “each of said elements being … continuously controllable … to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports.”

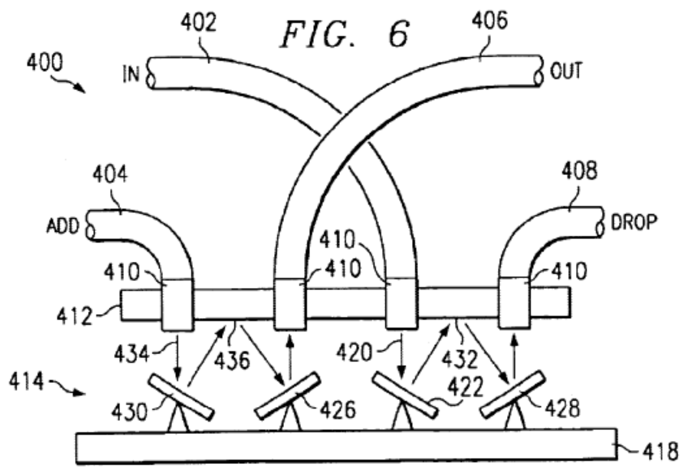
210. Tew ’640 discloses the micromirrors or deflecting members being moveable to direct the light beams. The micromirrors or deflecting members (reference numbers 422, 426, 428, and 430) can move to deflect the light beam from one port to another, as seen in the various embodiments shown in Figures 4-8, reprinted below.



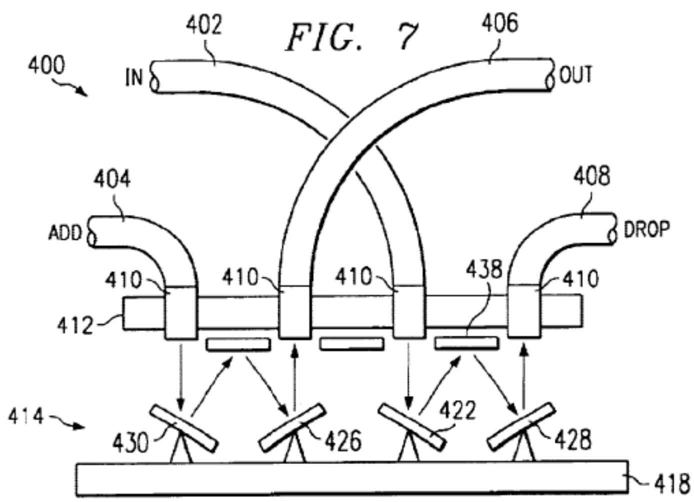
Tew ’640 at FIG. 4; *see also* Provisional Application No. 60/236,532 at FIG. 4.



Tew ’640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.

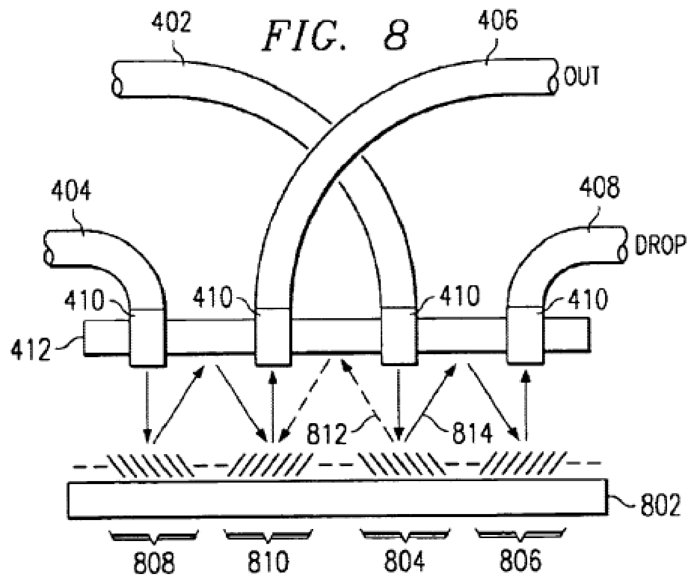


Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



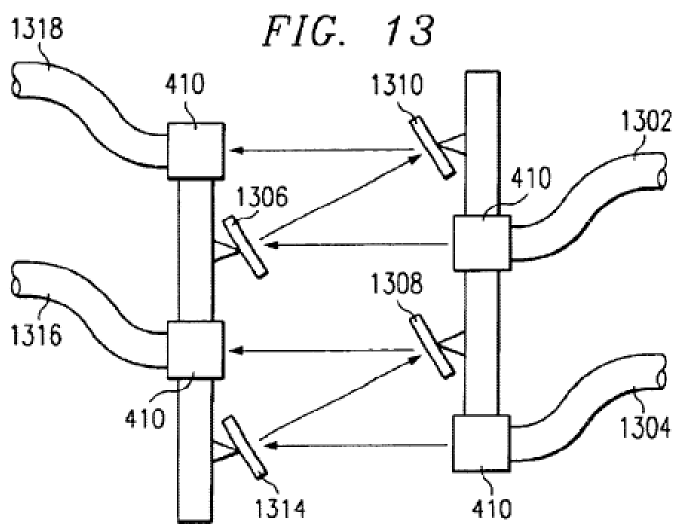
Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.

FIG. 8

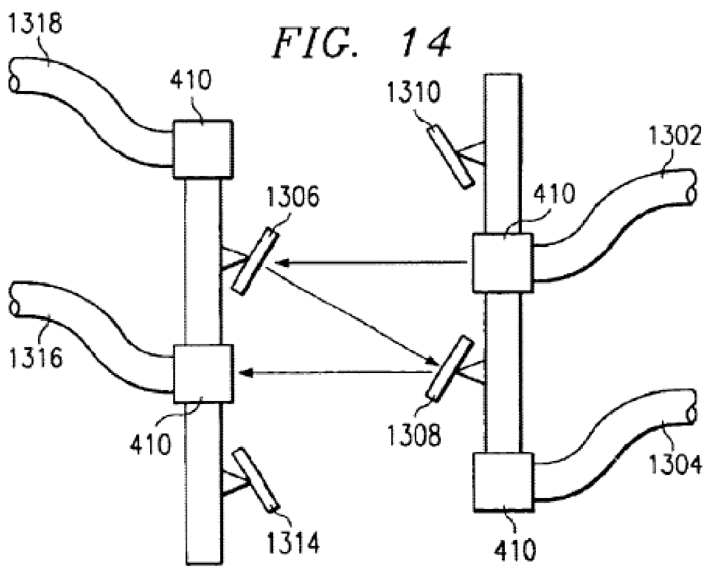


Tew '640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

211. Further evidence of the mirrors being moveable can be found in the descriptions of Figures 13 and 14, reprinted below. "[T]he deflecting members may be comprised of four moveable members, or arrays of moveable members, or just two moveable members, or arrays of moveable members, in combination with two stationary deflecting members. Furthermore, the stationary deflecting members, like the moveable members, may have curved as well as flat optical surfaces." Tew '640 at 11:27-41; *see also* Provisional Application No. 60/236,532 at 21:11-19.



Tew ’640 at FIG. 13; *see also* Provisional Application No. 60/236,532 at FIG. 13.

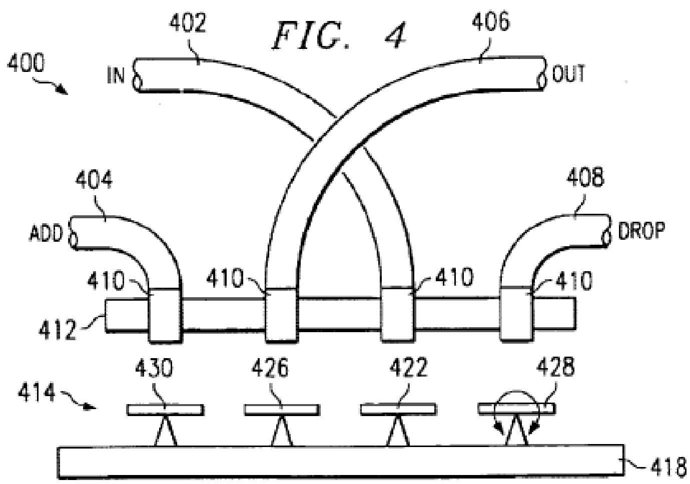


Tew ’640 at FIG. 14; *see also* Provisional Application No. 60/236,532 at FIG. 14.

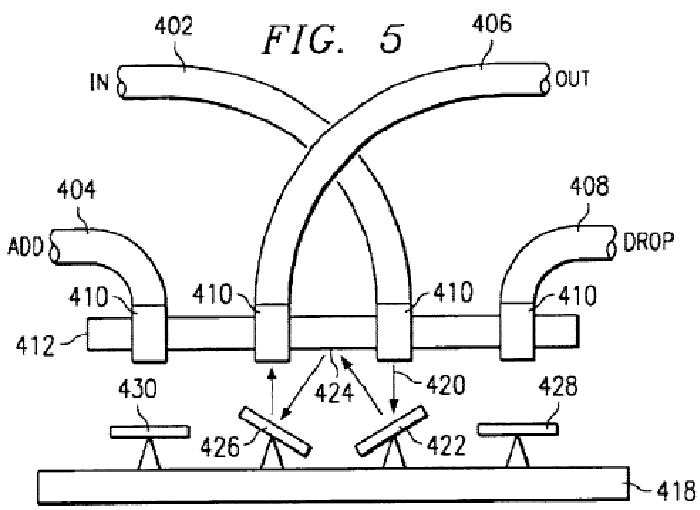
212. Tew ’640 discloses to a POSITA “each of said elements being individually and continuously controllable … to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports.”

213. As shown in Figures 4-8, reprinted below, Tew ’640 discloses each mirror being rotated in a clockwise or counterclockwise direction around a torsion axis. “[E]ach mirror is

selectively rotated in either a clockwise or counterclockwise direction." Tew '640 at 5:33-41; *see also id.* at 8:32-40; Provisional Application No. 60/236,532 at 10:12-17, 16:1-6 ("The micromirror array 414 of FIG. 4 includes four discrete mirrors 416. Each of the mirrors 422, 426, 428, 430 is operable to tilt clockwise or counterclockwise about an axis perpendicular to the plane of FIG. 4.").

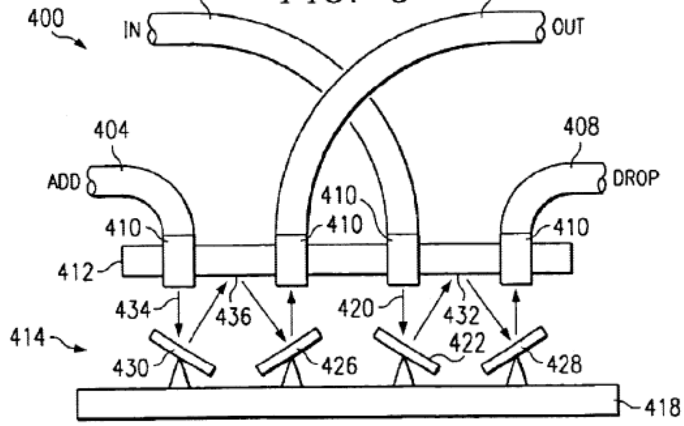


Tew '640 at FIG. 4; *see also* Provisional Application No. 60/236,532 at FIG. 4.



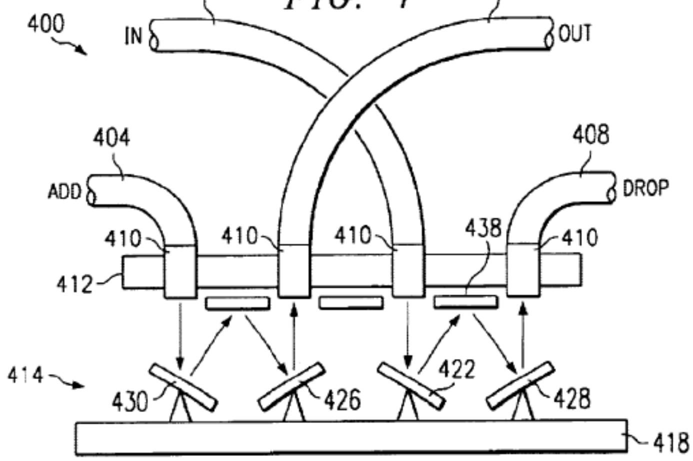
Tew '640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.

FIG. 6



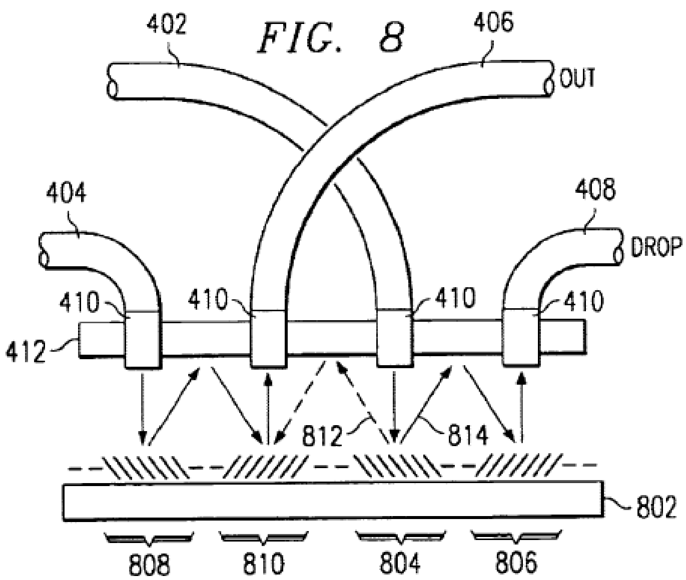
Tew '640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.

FIG. 7



Tew '640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.

FIG. 8



Tew '640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

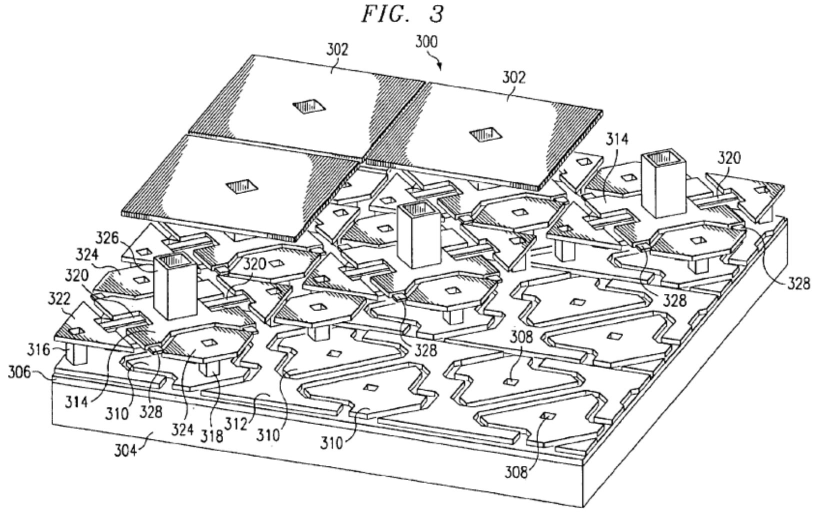
214. Therefore, Tew '640 discloses to a POSITA "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being … continuously controllable … to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports." Even Tew '640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Tew '640 not teach "each of said elements being individually … controllable in two dimensions … and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(viii) *'905 Patent, [24] "The optical add-drop apparatus of claim 23 further comprising a control unit for controlling each of said beam-deflecting elements"*

215. Tew '640 discloses to a POSITA "a control unit for controlling each of said beam-deflecting elements."

216. Tew '640 discloses circuitry used to control the direction of rotation of a micromirror mirror. "For the purposes of this disclosure, addressing circuitry is considered to include any circuitry, including direct voltage connections and shared memory cells, used to control the direction of rotation of a micromirror mirror." Tew '640 at 5:57-6:4; *see also* Provisional Application No. 60/236,532 at 11:4-13. See also FIG. 3, reprinted below.

FIG. 3



Tew '640 at FIG. 3; *see also* Provisional Application No. 60/236,532 at FIG. 3.

217. Therefore, Tew '640 discloses to a POSITA "the optical add-drop apparatus of claim 23 further comprising a control unit for controlling each of said beam-deflecting elements." Even if Tew '640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(ix) *'905 Patent, [25] "The optical add-drop apparatus of claim 24, wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements"*

218. Tew '640 discloses "a processing unit responsive to said power levels for controlling said beam-deflecting elements. To the extent Tew '640 not teach "wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

219. Tew '640 discloses to a POSITA "a processing unit responsive to said power levels for controlling said beam-deflecting elements."

220. Tew '640 discloses electrical control circuitry suing standard integrated circuit process flows to control the direction of rotation of a micromirror mirror. "Electrical control circuitry typically is fabricated in or on the surface of the semiconductor substrate 304 using standard integrated circuit process flows. This circuitry typically includes, but is not limited to, a memory cell associated with, and typically underlying, each mirror 302 and digital logic circuits to control the transfer of the digital image data to the underlying memory cells. Voltage driver circuits to drive bias and reset signals to the mirror superstructure may also be fabricated on the micromirror substrate, or may be external to the micromirror. Image processing and formatting logic is also formed in the substrate 304 of some designs. For the purposes of this disclosure, addressing circuitry is considered to include any circuitry, including direct voltage connections and shared memory cells, used to control the direction of rotation of a micromirror mirror." Tew '640 at 5:57-6:4; *see also* Provisional Application No. 60/236,532 at 11:4-13.

221. Therefore, Tew ’640 to a POSITA “a processing unit responsive to said power levels for controlling said beam-deflecting elements.” Even if Tew ’640 not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Tew ’640 not teach “wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels[,]” these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(x) *’905 Patent, [26] “The optical add-drop apparatus of claim 25, wherein said servo-control assembly maintains said power levels at predetermined values”*

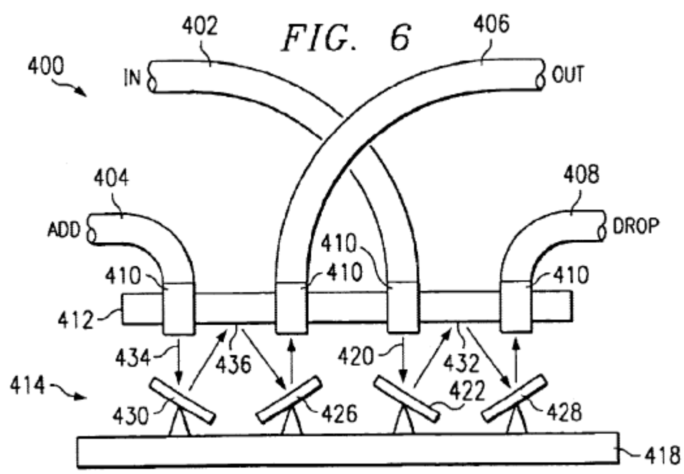
222. To the extent Tew ’640 does not teach “wherein said servo-control assembly maintains said power levels at predetermined values[,]” these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xi) *’905 Patent, [27] “The optical add-drop apparatus of claim 24, wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal”*

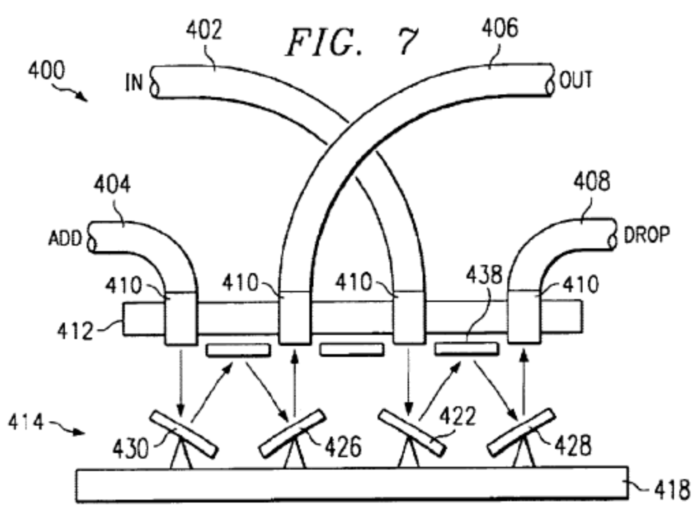
223. Tew ’640 to a POSITA “wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal.”

224. Tew ’640 discloses a switch used to pass a received signal along the network, add a new signal to the transmission stream, or drop a signal from the transmission stream. Tew

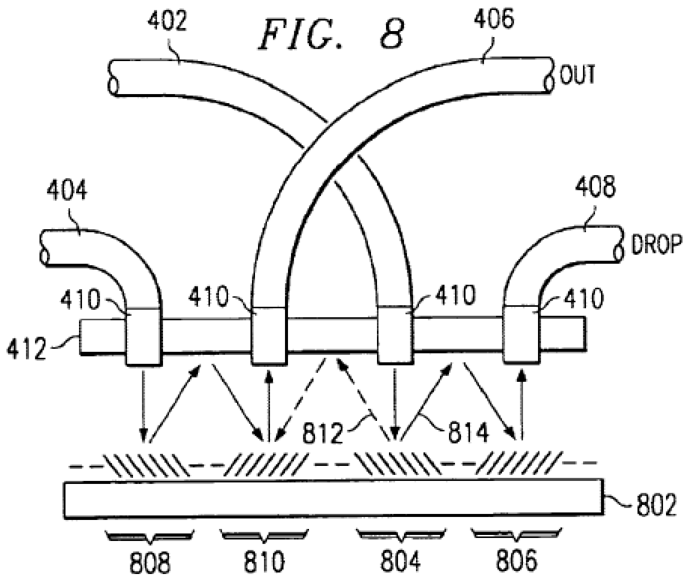
’640 at 4:66-5:3; *see also id.* at Abstract; Provisional Application No. 60/236,532 at 9:12-14, Abstract. Figures 6-8, reprinted below, show a signal from an input fiber being reflected to a fiber to be dropped from the transmission stream. For example, “[i]n FIG. 6, the first mirror 422 is rotated clockwise to a second position. In the second position, the first mirror 422 reflects light beam 420 from the first input fiber 402 to a second point or region 432 on the holding block 412. From the second region 432, the light beam 420 travels to a second mirror 428 and is reflected to the second output fiber 408, the "drop" fiber.” Tew ’640 at 8:56-64; *see also* Provisional Application No. 60/236,532 at 16:17-22.



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.



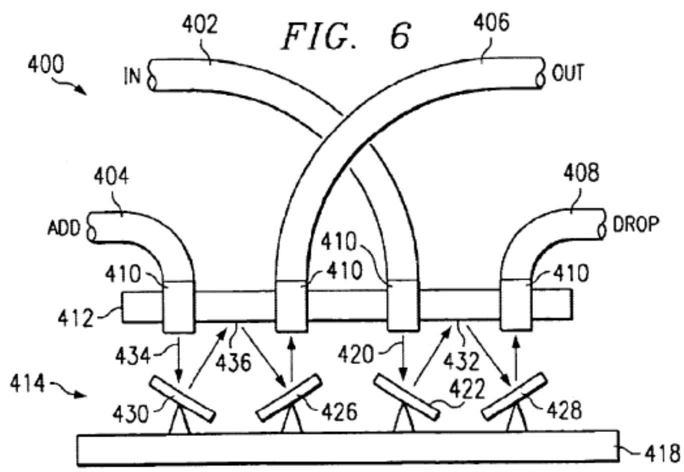
Tew ’640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

225. Therefore, Tew ’640 discloses to a POSITA “wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal.” Even if Tew ’640 not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

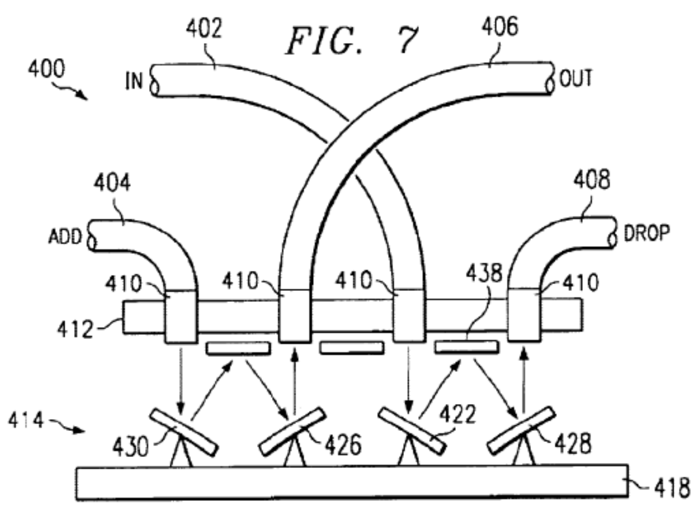
(xii) *’905 Patent, [28] “The optical add-drop apparatus of claim 24, wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal”*

226. Tew ’640 discloses to a POSITA “wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal.”

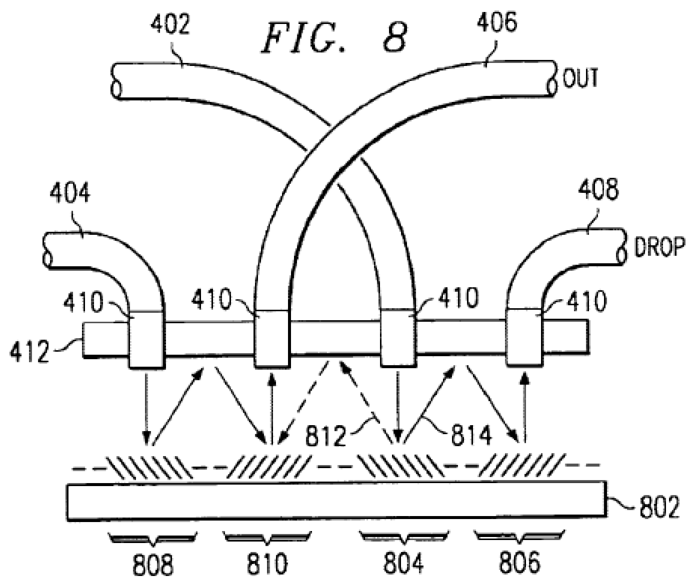
227. Tew '640 discloses a switch used to pass a received signal along the network, add a new signal to the transmission stream, or drop a signal from the transmission stream. Tew '640 at 4:66-5:3; *see also id.* at Abstract; Provisional Application No. 60/236,532 at 9:12-14, Abstract. Figures 6-8, reprinted below, show a signal from an input fiber being reflected to a fiber to be added to the transmission stream. For example, "light beam 434 is provided to the first output fiber 406. The second light beam 434 exits the second input fiber 404, the "add" fiber." Tew '640 at 8:65-9:1; *see also* Provisional Application No. 60/236,532 at 17:1-3.



Tew '640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew '640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.



Tew ’640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

228. Therefore, Tew ’640 discloses to a POSITA “wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

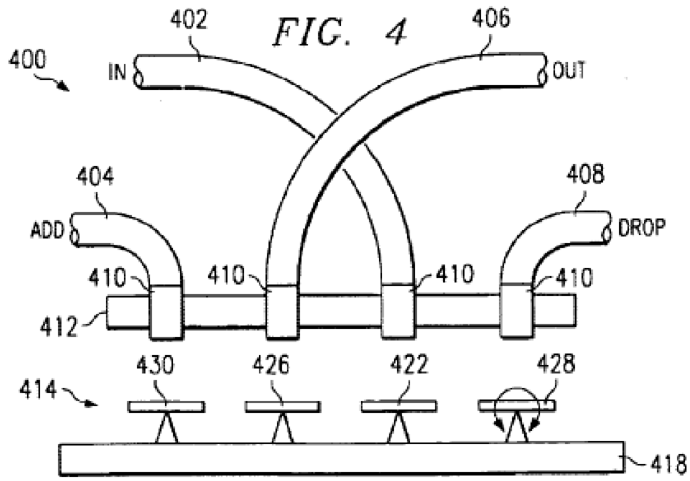
(xiii) *’905 Patent, [29] “The optical add-drop apparatus of claim 23 further comprising alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device”*

229. Tew ’640 discloses to a POSITA “alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device.”

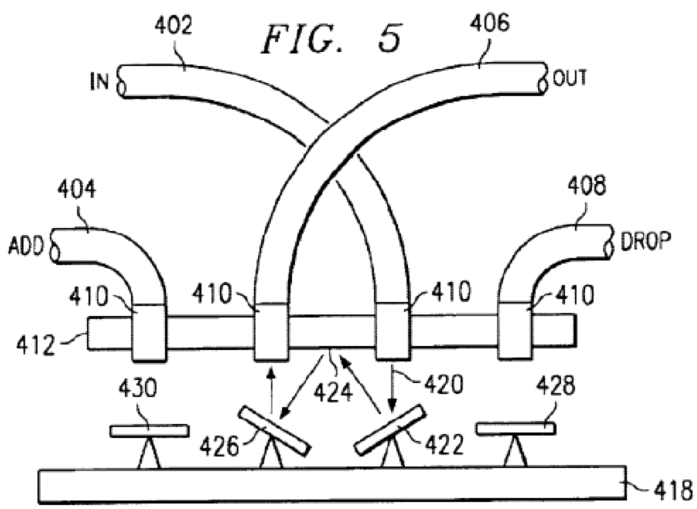
230. Tew ’640 discloses mirrors that can be shaped to help focus the light form one fiber or mirror to the next, thus simplifying the alignment of the OADM. For example, “in some applications using a spherical or aspherical curved deflecting surface helps to focus the light

from one fiber or mirror to the next, or helps to simplify alignment of the OADM during assembly." Tew '640 at 11:27-41; *see also* Provisional Application No. 60/236,532 at 21:11-19.

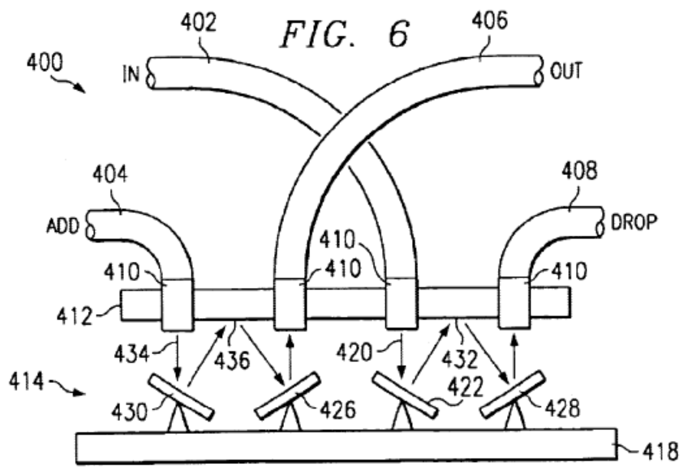
231. Figures 4-7 of Tew '640 , reprinted below, disclose mirrors assigned to each fiber, positioned to receive light from one of the input fibers and transmit light to one of the output fibers. For example, one mirror can receive light from an input fiber (reference numbers 422 and 402, respectively), another mirror can receive light from an add fiber (reference numbers 430 and 404, respectively), another mirror can transmit light to an output fiber (reference numbers 426 and 406, respectively), and another mirror can transmit light to a drop fiber (reference numbers 428 and 408, respectively). For example, "[i]n FIG. 6, the first mirror 422 is rotated clockwise to a second position. In the second position, the first mirror 422 reflects light beam 420 from the first input fiber 402 to a second point or region 432 on the holding block 412. From the second region 432, the light beam 420 travels to a second mirror 428 and is reflected to the second output fiber 408, the "drop" fiber." Tew '640 at 8:56-64; *see also* Provisional Application No. 60/236,532 at 16:17-22. As another example, "[t]he second light beam 434 exits the second input fiber 404, the "add" fiber, and is reflected by a third mirror 430 to a third point or region 436 on the holding block 412. From the third region 436, the light travels to the fourth mirror 426 which, when in a second position shown in FIG. 6 (rotated counterclockwise), directs the second light beam 434 to the first output fiber 406." Tew '640 at 8:67-9:6; *see also* Provisional Application No. 60/236,532 at 17:2-6.



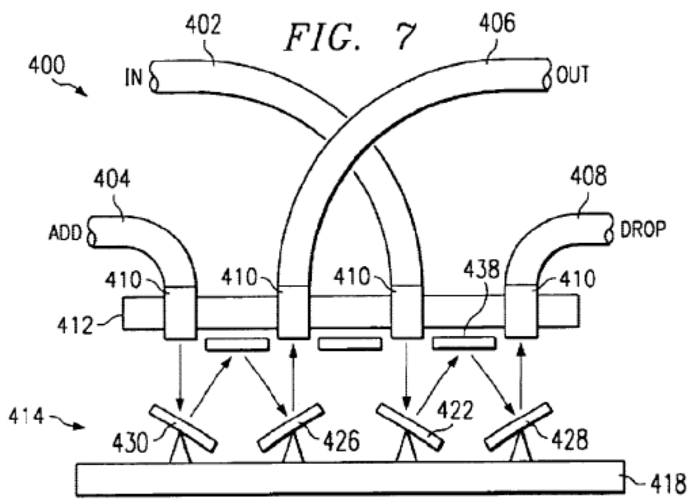
Tew ’640 at FIG. 4; *see also* Provisional Application No. 60/236,532 at FIG. 4.



Tew ’640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.

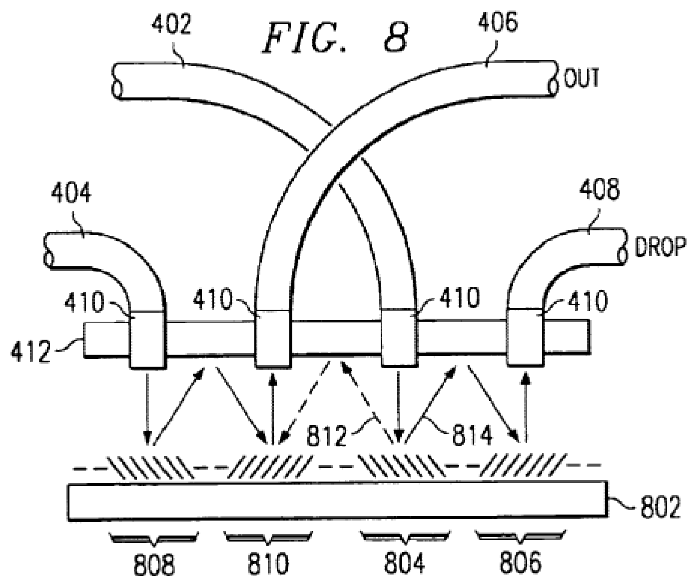
232. Therefore, Tew ’640 discloses to a POSITA “alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xiv) *'905 Patent, [31] "The optical add-drop apparatus of claim 23, wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal"*

233. Tew '640 discloses to a POSITA "wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal."

234. Tew '640 discloses combining multiple wavelengths into an output. For example, "when light beam 902 is reflected by the second region 912 of the retro-reflector, it again travels to the mirror array 908 and is then reflected to a wavelength combiner 914 and output on the second ("drop") output fiber 408." Tew '640 at 9:67-10:4; *see also id.* at Abstract; Provisional Application No. 60/236,532 at 18:19-21, Abstract. Figure 8 of Tew '640 , reprinted below, shows that light from an input fiber (reference number 402) can be reflected to an output fiber (reference number 410), and light from an add fiber (reference number 404) can also be reflected to the output fiber (reference number 410), thus combining the multiple wavelengths, e.g., the input signal and the add signal, into an output signal. For example, when "light from a first input fiber 402 is deflected by a first deflector, typically a group 804 of micromirrors. When the deflector 804 is in a first position, the input light is directed along a first path 812 to a fourth deflector 810 and then to a first output fiber 406. When the deflector 804 is in a second position, the input light is directed along a second path 814 to a second deflector 806 and from the second deflector 806 to a second output 408. Light from a second input 404 is directed by deflector 808 along a path to the fourth deflector 810 and from there to the first output 406." Tew '640 at 9:67-10:4; *see also* Provisional Application No. 60/236,532 at 18:19-21.

FIG. 8



Tew ’640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

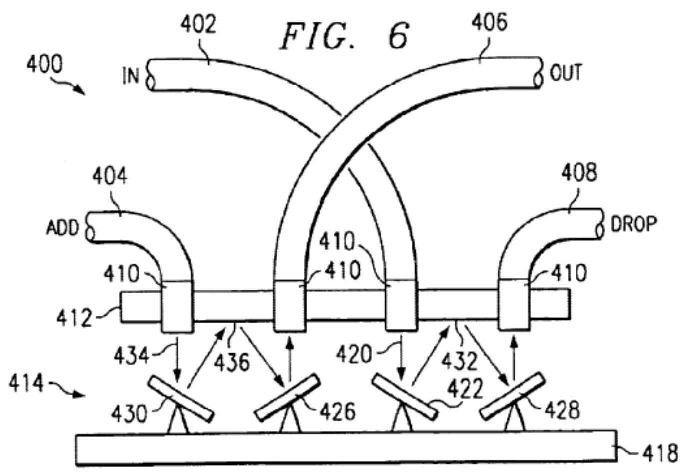
235. Therefore, Tew ’640 discloses to a POSITA “wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xv) *’905 Patent, [32] “The optical add-drop apparatus of claim 23, wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels”*

236. Tew ’640 discloses to a POSITA “wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels.”

237. Tew ’640 discloses a first input signal from an input fiber (reference number 402) being dropped at a drop fiber (reference number 408). At the same time, a second input signal from an add fiber (reference number 404 is added at the output fiber (reference number 406).

This is shown in Figure 6, reprinted below. For example, "[i]n FIG. 6, the first mirror 422 is rotated clockwise to a second position. In the second position, the first mirror 422 reflects light beam 420 from the first input fiber 402 to a second point or region 432 on the holding block 412. From the second region 432, the light beam 420 travels to a second mirror 428 and is reflected to the second output fiber 408, the "drop" fiber." Tew '640 at 8:57-64; *see also* Provisional Application No. 60/236,532 at 16:18-22. As such, light from the input fiber is dropped at the drop fiber, and similarly, light from the add fiber is added at the output fiber.



Tew '640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.

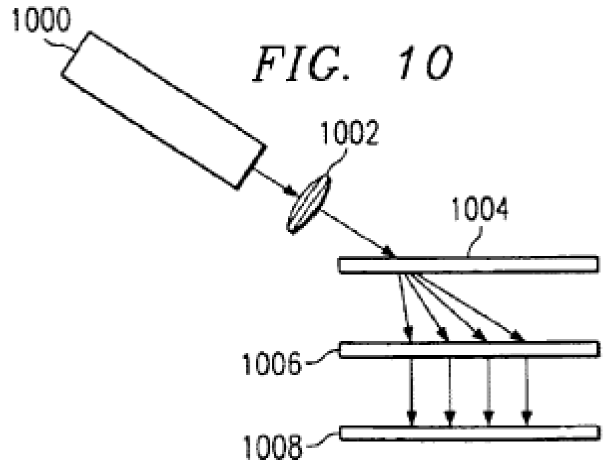
238. Additionally, components such as fiber collimators can be added to different portions of the embodiments, as would suit the optical designer. For example, "focusing optics may be added between the input fibers and the wavelength separators, between the wavelength combiners 914 and the output fibers, and between the mirror array 908 and separators 906 or combiners 914. Furthermore, although shown as separate separators 906 and combiners 914, it should be understood that other configurations are intended by this disclosure." Tew '640 at 10:21-34; *see also* Provisional Application No. 60/236,532 at 19:9-17.

239. Therefore, Tew ’640 discloses to a POSITA “wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

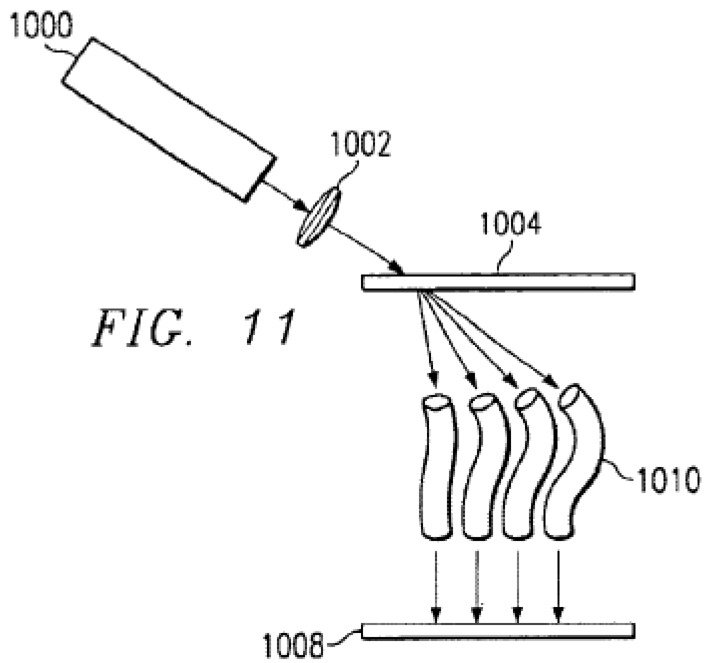
(xvi) *’905 Patent, [33] “The optical add-drop apparatus of claim 23 further comprising a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements”*

240. Tew ’640 discloses to a POSITA “a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements.”

241. Tew ’640 discloses focusing optics, such as gradient lenses, to control dispersion of light exiting a fiber. *See* Tew ’640 at 8:23-25; *see also* Provisional Application No. 60/236,532 at 15:18-19. The “focusing optics may be added between the input fibers and the wavelength separators, between the wavelength combiners 914 and the output fibers, and between the mirror array 908 and separators 906 or combiners 914.” Tew ’640 at 10:21-34; *see also* Provisional Application No. 60/236,532 at 19:9-17. As a further example, and as shown in Figures 10-11 (reprinted below), “light from an input fiber 1000 is collimated by an optic 1002 and strikes a beam separator such as diffraction grating 1004. The diffraction grating spatially separates the component beams of the input light beam. The component beams are directed by a second focusing optic 1006 to the mirror array 1008.” Tew ’640 at 10:35-43; *see also id.* at 10:44-56; Provisional Application No. 60/236,532 at 19:18-23, 20:1-9. (“In FIG. 11, light from the input fiber 1000 again is focused onto a beam separator such as diffraction grating 1004 by a focusing optic 1002. The separated beams are then individually captured by a set of optical fibers 1010.”)



Tew ’640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10.



Tew ’640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11.

242. Additionally, Tew ’640 discloses mirrors that can be shaped to help focus the light form one fiber or mirror to the next, thus simplifying the alignment of the OADM. For example, "in some applications using a spherical or aspherical curved deflecting surface helps to focus the light from one fiber or mirror to the next, or helps to simplify alignment of the OADM

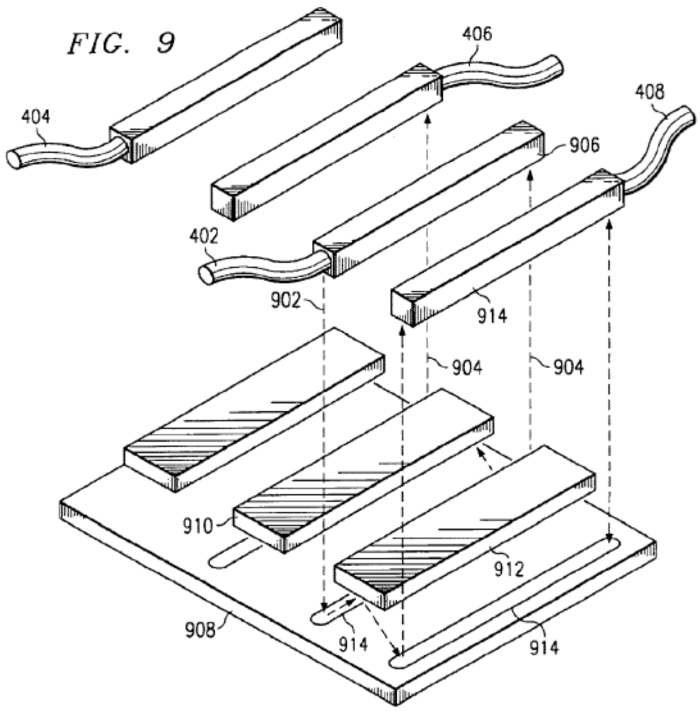
during assembly." Tew ’640 at 11:27-41; *see also* Provisional Application No. 60/236,532 at 21:11-19.

243. Therefore, Tew ’640 discloses to a POSITA “a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xvii) *’905 Patent, [34] “The optical add-drop apparatus of claim 23, wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms”*

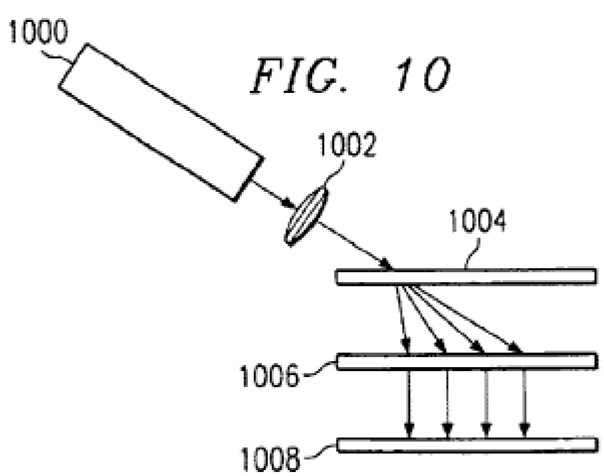
244. Tew ’640 discloses to a POSITA “wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms.”

245. Tew ’640 discloses different forms of gratings. As shown in Figure 9 (reprinted below), “although shown as separate separators 906 and combiners 914, it should be understood that [] other configurations are intended by this disclosure. For example, a single diffraction grating or prism could replace all of the separators and combiners.” Tew ’640 at 10:21-34; *see also* Provisional Application No. 60/236,532 at 19:9-17.



Tew '640 at FIG. 9; *see also* Provisional Application No. 60/236,532 at FIG. 9.

246. As another example, Figure 10 (reprinted below) shows "light from an input fiber 1000 is collimated by an optic 1002 and strikes a beam separator such as diffraction grating 1004. The diffraction grating spatially separates the component beams of the input light beam." Tew '640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23.



Tew '640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10.

247. As another example, Figure 11 (reprinted below) shows "a second beam splitting apparatus used in the DWDM OADM of FIG. 9. In FIG. 11, light from the input fiber 1000 again is focused onto a beam separator such as diffraction grating 1004 by a focusing optic 1002." Tew '640 at 10:44-56; *see also* Provisional Application No. 60/236,532 at 20:1-9.

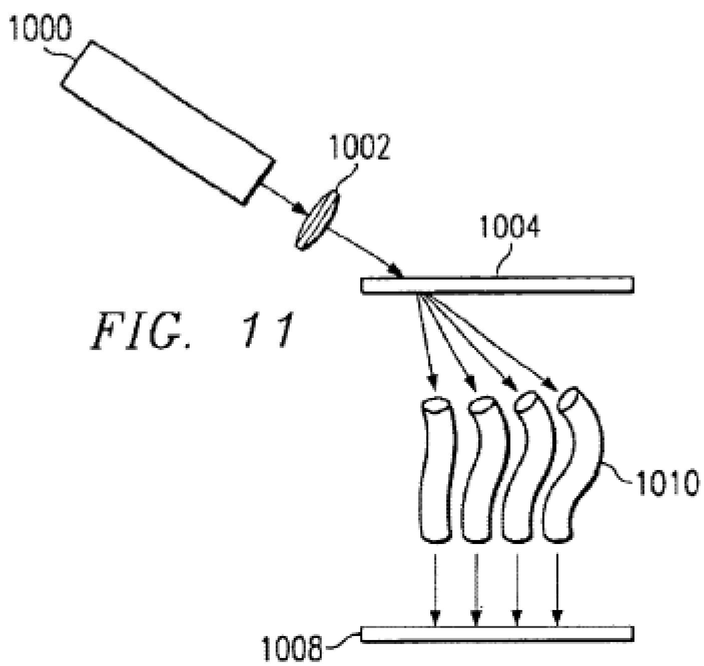


FIG. 11

Tew '640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11.

248. As another example, Figure 12 (reprinted below) shows "another beam splitting device used in the DWDM OADM of FIG. 9. In FIG. 12, light from the input fiber 1000 enters an arrayed waveguide grating, also known as a PHASAR. The arrayed waveguide grating router includes a series of arrayed channel waveguides which function as a diffraction grating."

249. Tew '640 at 10:57-65; *see also* Provisional Application No. 60/236,532 at 20:10-15.

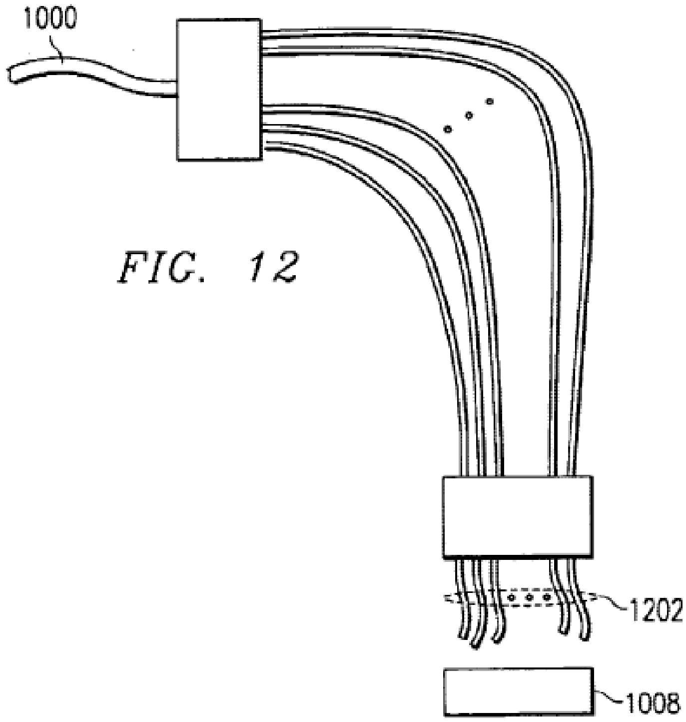


FIG. 12

Tew ’640 at FIG. 12; *see also* Provisional Application No. 60/236,532 at FIG. 12.

250. Therefore, Tew ’640 discloses to a POSITA “wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

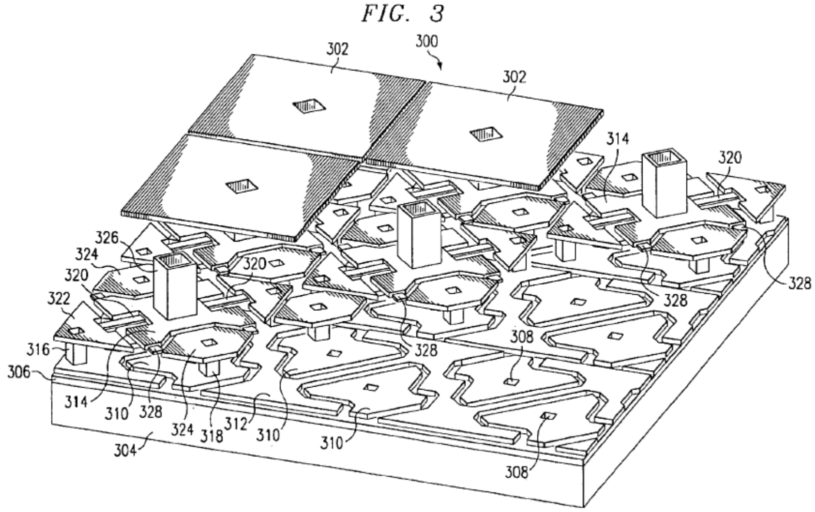
(xviii) *’905 Patent, [35] “The optical add-drop apparatus of claim 23, wherein said beam-deflecting elements comprise micromachined mirrors”*

251. Tew ’640 discloses to a POSITA “wherein said beam-deflecting elements comprise micromachined mirrors.”

252. Tew ’640 discloses micromachined mirrors that are used in the OADM. For example, as shown in Figure 3 (reprinted below), a “micromirror device [is] used in the optical

switch of the present invention. The micromirror shown in FIG. 3 is a hidden-hinge type, so called because the mirror 302 is elevated over the torsion hinges 320 such that the hinges 120 and remainder of the superstructure are shielded, or hidden, from the incident light. The micromirror 300 is an orthogonal array of micromirror cells, or elements, that often includes more than a thousand rows and columns of micromirrors. FIG. 3 shows a small portion of a micromirror array of the prior art with several mirrors 302 removed to show the underlying mechanical structure of the micromirror array. Tew ’640 at 5:42-54; *see also id.* at 5:55-56; Provisional Application No. 60/236,532 at 10:18-11:2, 11:3 (“The micromirror 300 is fabricated on a semiconductor, typically silicon, substrate 304.”).

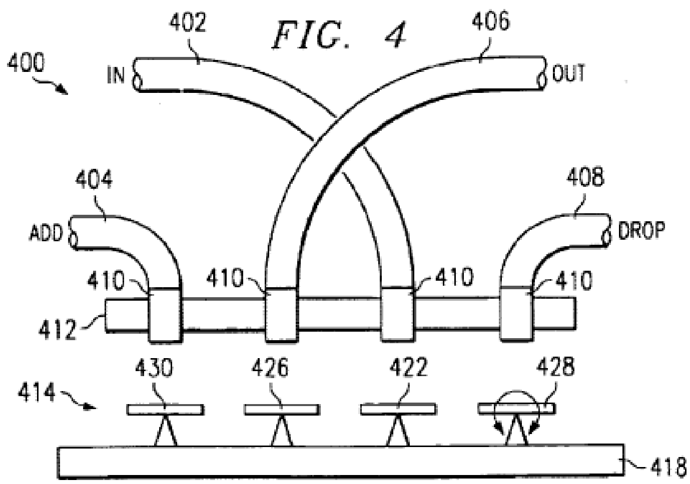
FIG. 3



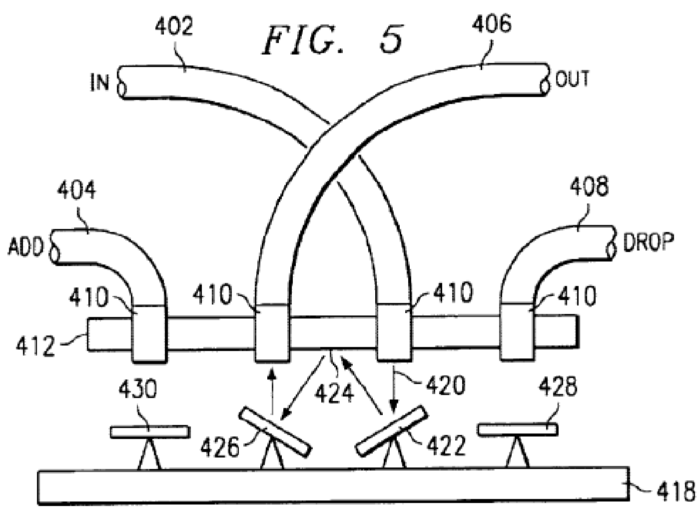
Tew ’640 at FIG. 3; *see also* Provisional Application No. 60/236,532 at FIG. 3.

253. As shown in Figures 4-7, reprinted below, Tew ’640 discloses each mirror being rotated in a clockwise or counterclockwise direction around a torsion axis. “[E]ach mirror is selectively rotated in either a clockwise or counterclockwise direction.” Tew ’640 at 5:33-41; *see also id.* at 8:32-40; Provisional Application No. 60/236,532 at 10:12-17, 16:1-6 (“The micromirror array 414 of FIG. 4 includes four discrete mirrors 416. Each of the mirrors 422,

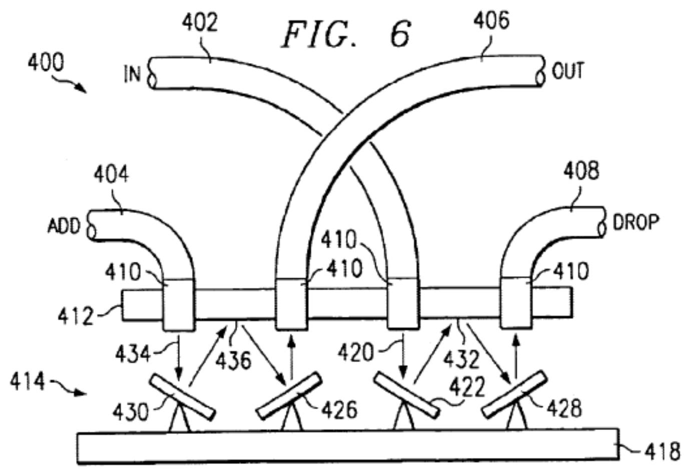
426, 428, 430 is operable to tilt clockwise or counterclockwise about an axis perpendicular to the plane of FIG. 4.").



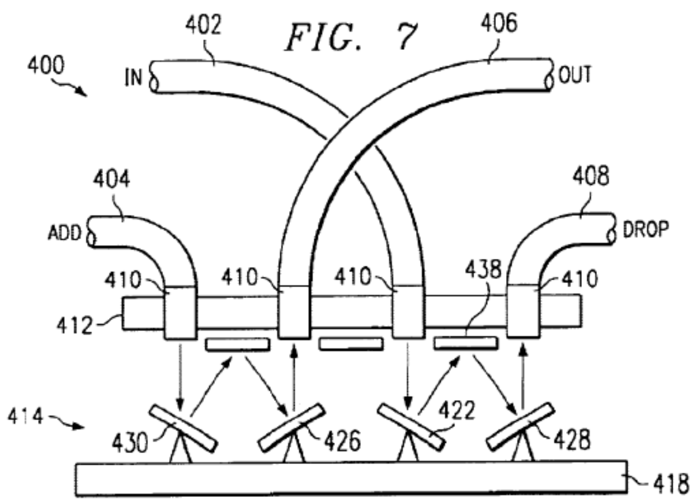
Tew '640 at FIG. 4; *see also* Provisional Application No. 60/236,532 at FIG. 4.



Tew '640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.

254. Therefore, Tew ’640 discloses to a POSITA “wherein said beam-deflecting elements comprise micromachined mirrors.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xix) *'905 Patent, [37] "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator"*

255. Tew '640 discloses to a POSITA "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator." Tew '640 does not include circulators in any of its claims, figures, or in the specification.

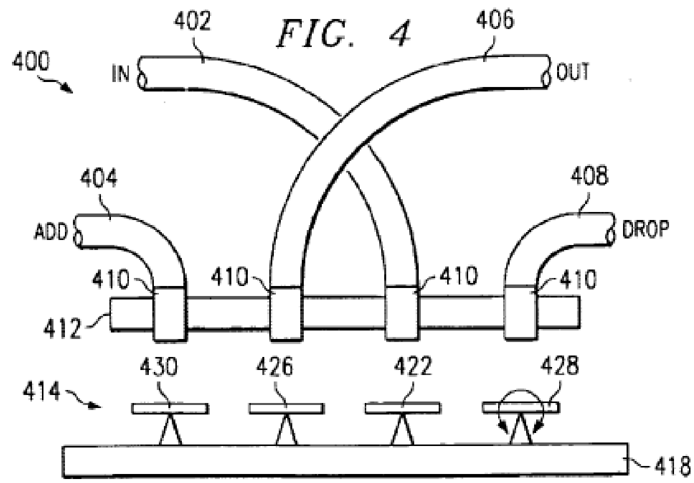
256. Therefore, Tew '640 discloses to a POSITA "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator." Even if Tew '640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xx) *'905 Patent, [39] "The optical add-drop apparatus of claim 23, wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array"*

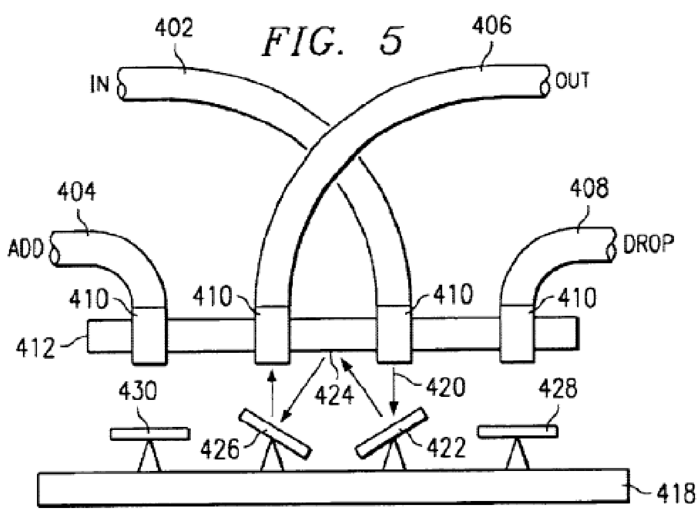
257. Under Capella's apparent interpretation, Tew '640 discloses to a POSITA "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array."

258. As shown in Figures 4-8 (reprinted below), Tew '640 discloses the input fiber, the output fiber, the add fiber, and the drop fiber being arranged in a one-dimensional array. Being arranged in a one-dimensional array, the mirrors (reference numbers 422, 426, 428, 430) can tilt in either direction (e.g., left or right) to reflect a signal from the input fiber or the add fiber to the output fiber or the drop fiber. "The micromirror array 414 of FIG. 4 includes four discrete mirrors 416. Each of the mirrors 422, 426, 428, 430 is operable to tilt clockwise or counterclockwise about an axis perpendicular to the plane of FIG. 4. The supporting structure of

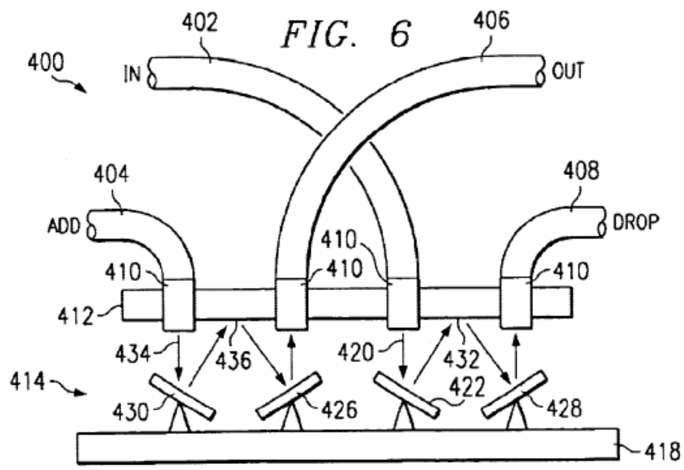
the mirrors is not shown, but instead each mirror is illustrated as supported on the tip of a triangle to show that each mirror is operable to tilt in either direction. The mirrors of FIG. 4 are all fabricated on a single substrate 418." Tew '640 at 8:32-40; *see also* Provisional Application No. 60/236,532 at 16:1-6.



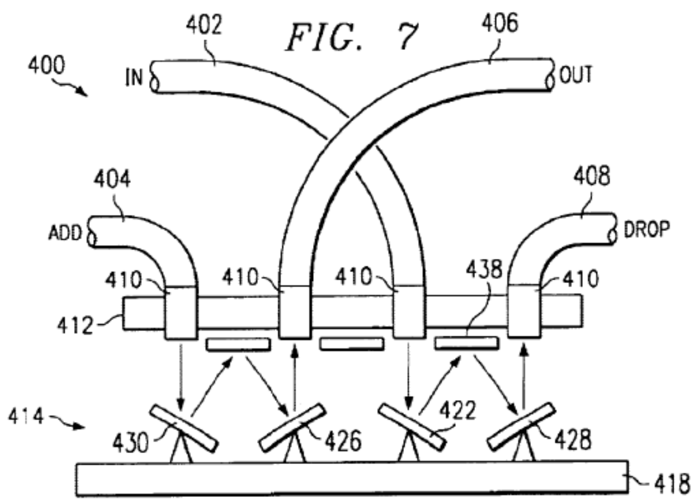
Tew '640 at FIG. 4; *see also* Provisional Application No. 60/236,532 at FIG. 4.



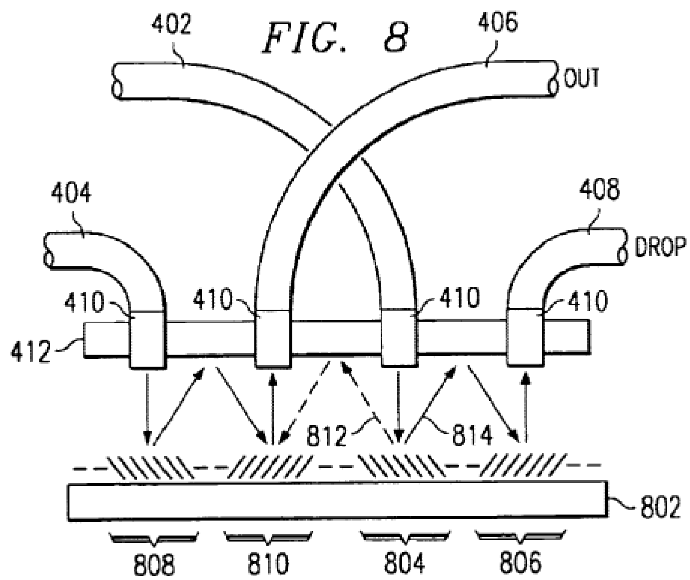
Tew '640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.



Tew ’640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

259. Additionally, components such as fiber collimators can be added to different portions of the embodiments, as would suit the optical designer. For example, "focusing optics may be added between the input fibers and the wavelength separators, between the wavelength combiners 914 and the output fibers, and between the mirror array 908 and separators 906 or combiners 914. Furthermore, although shown as separate separators 906 and combiners 914, it should be understood that other configurations are intended by this disclosure." Tew ’640 at 10:21-34; *see also* Provisional Application No. 60/236,532 at 19:9-17.

260. Therefore, under Capella’s apparent interpretation, Tew ’640 discloses to a POSITA “wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxi) *'905 Patent, [44] "The optical add-drop apparatus of claim 23, further comprising a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels"*

261. To the extent Tew '640 does not teach "a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxii) *'905 Patent, [45] "The optical add-drop apparatus of claim 44, wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port"*

262. To the extent Tew '640 does not teach "wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxiii) *'905 Patent, [46] "The optical add-drop apparatus of claim 23, wherein the beam-deflecting elements are micromirrors"*

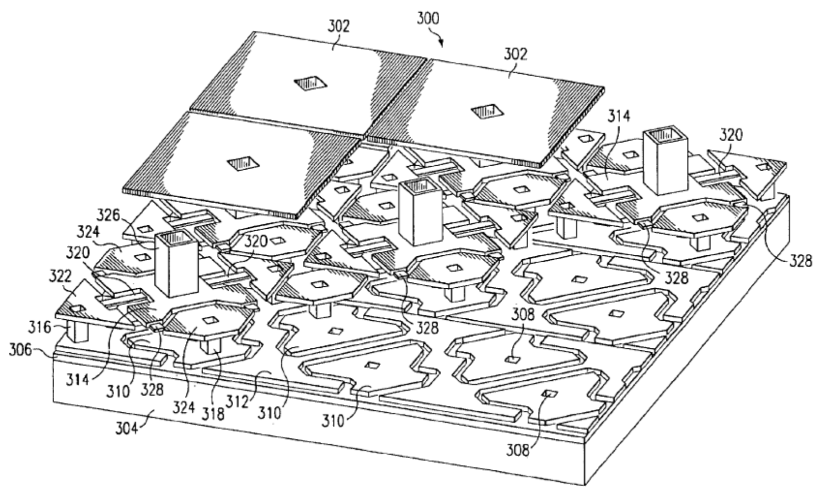
263. Tew '640 discloses to a POSITA "wherein the beam-deflecting elements are micromirrors."

264. "Tew '640 discloses an OADM that "uses micromirrors to switch signals between input and output signal streams efficiently." Tew '640 at 4:13-19; *see also* Provisional Application No. 60/236,532 at 8:2-5. "The new OADM requires a component capable of selectively directing an incoming optical signal along one of at least two paths. A micromirror device is preferred. The micromirror used in the OADM operates using electromagnetic, electrostatic, piezoelectric, or other force. The micro mirror is an array of mirrors fabricated on a common substrate, or an array of mirrors separately fabricated and assembled into the OADM.

The mirrors are silicon, gold, aluminum, or other metals or materials capable of reflecting the signal energy in the wavelengths transmitted by the switch. If the mirrors are sufficiently large, a single mirror is used to reflect each signal. Alternatively, a number of small mirrors are used to collectively reflect the each signal." Tew '640 at 5:19-32; *see also* Provisional Application No. 60/236,532 at 10:3-11.

265. "FIG. 3 is a perspective view of a portion of a typical micromirror device used in the optical switch of the present invention. The micromirror shown in FIG. 3 is a hidden-hinge type, so called because the mirror 302 is elevated over the torsion hinges 320 such that the hinges 120 and remainder of the superstructure are shielded, or hidden, from the incident light. The micromirror 300 is an orthogonal array of micromirror cells, or elements, that often includes more than a thousand rows and columns of micromirrors. FIG. 3 shows a small portion of a micromirror array of the prior art with several mirrors 302 removed to show the underlying mechanical structure of the micromirror array. Tew '640 at 5:42-54; *see also id.* at 5:55-6:12; Provisional Application No. 60/236,532 at 10:18-11:2, 11:3-18.

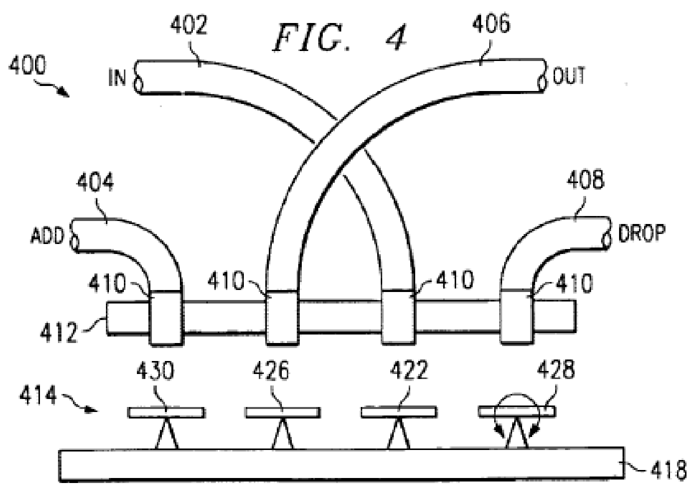
FIG. 3



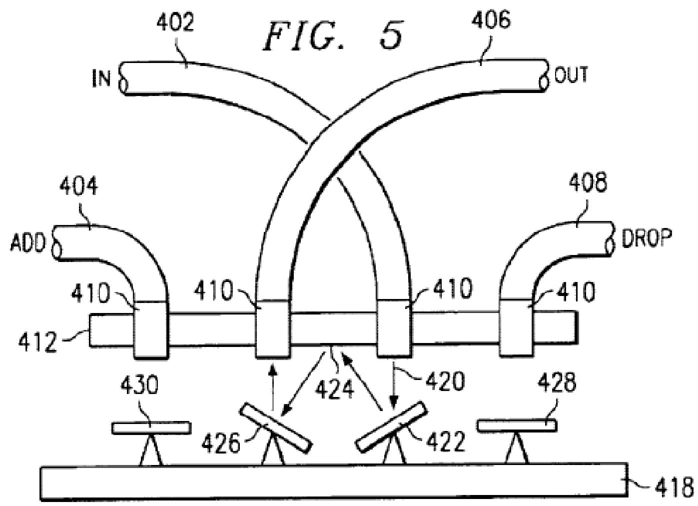
Tew '640 at FIG. 3; *see also* Provisional Application No. 60/236,532 at FIG. 3.

266. Figures 4-7 (reprinted below) further illustrate the use of micromirrors as the beam-deflecting elements. For example, "[t]he micromirror array 414 of FIG. 4 includes four discrete mirrors 416. Each of the mirrors 422, 426, 428, 430 is operable to tilt clockwise or counterclockwise about an axis perpendicular to the plane of FIG. 4. The supporting structure of the mirrors is not shown, but instead each mirror is illustrated as supported on the tip of a triangle to show that each mirror is operable to tilt in either direction. The mirrors of FIG. 4 are all fabricated on a single substrate 418." Tew '640 at 8:32-40; *see also* Provisional Application No. 60/236,532 at 16:1-6.

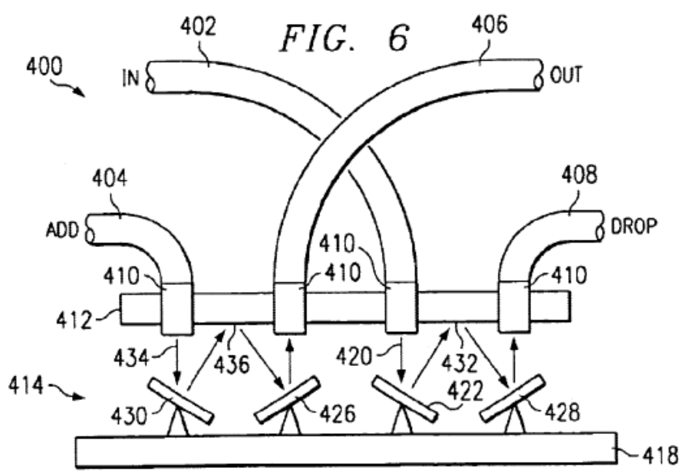
FIG. 4



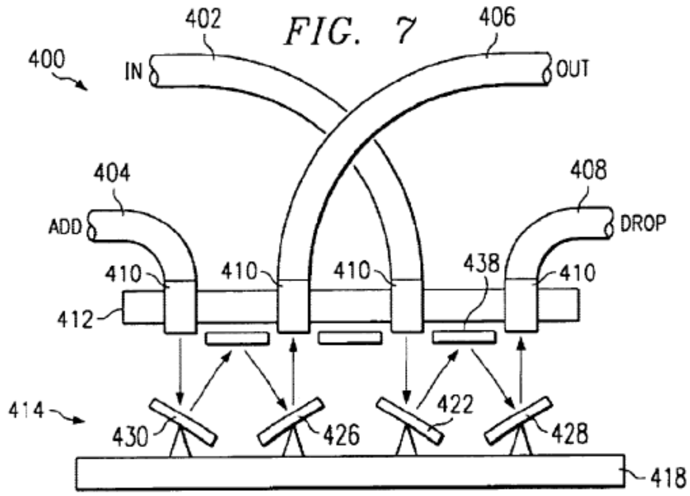
Tew '640 at FIG. 4; *see also* Provisional Application No. 60/236,532 at FIG. 4.



Tew ’640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.

267. Therefore, Tew ’640 discloses to a POSITA "wherein the beam-deflecting elements are micromirrors." Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxiv) *’905 Patent, [47-pre] “An optical add-drop apparatus, comprising”*

268. I previously analyzed Tew ’640 in view of the following limitations:

- “[a]n optical add-drop apparatus,” discussed above in Section IX.1.a.ii (Paragraphs 186-189).

I incorporate that analysis by reference.

(xxv) *’905 Patent, [47-a] “a fiber collimator serving as an input port for an input multi-wavelength optical signal having multiple spectral channels”*

269. I previously analyzed Tew ’640 in view of the following limitations:

- “fiber collimators serving as an input port . . . ,” discussed above in Section IX.1.a.ii (Paragraphs 186-189); and
- “the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels[,]” discussed above in Section IX.1.a.iii (Paragraphs 190-192).

I incorporate that analysis by reference.

(xxvi) *'905 Patent, [47-b] "an output port for an output multi-wavelength optical signal"*

270. I previously analyzed Tew '640 in view of the following limitations:

- "an output port . . . ," discussed above in Section IX.1.a.ii (Paragraphs 186-189); and
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.a.v (Paragraphs 197-199).

I incorporate that analysis by reference.

(xxvii) *'905 Patent, [47-c] "one or more fiber collimators serving as one or more drop ports for selected spectral channels dropped from said multi-wavelength optical signal"*

271. I previously analyzed Tew '640 in view of the following limitations:

- "fiber collimators serving as . . . one or more other ports . . . ," discussed above in Section IX.1.a.ii (Paragraphs 186-189);
- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.a.xi (Paragraphs 223-225);
- "wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.a.xv (Paragraphs 236-239).

I incorporate that analysis by reference.

(xxviii) *'905 Patent, [47-d] "a wavelength-selective device for spatially separating said multiple spectral channels"*

272. I previously analyzed Tew '640 in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.a.vi (Paragraphs 200-202).

I incorporate that analysis by reference.

(xxix) *'905 Patent, [47-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports and to control the power of the spectral channel reflected to said output port of the fiber collimator serving as said selected port, whereby a subset of said spectral channels is directed to said fiber collimator serving as said drop ports"*

273. I previously analyzed Tew '640 in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214);
- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.a.xi (Paragraphs 223-225); and
- "wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.a.xv (Paragraphs 236-239).

I incorporate that analysis by reference.

(xxx) *'905 Patent, [48] "The optical add-drop apparatus of claim 47, wherein none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"*

274. I previously analyzed Tew '640 in view of the following limitations:

- "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]" discussed above in Section IX.1.a.xix (Paragraphs 255-256).

I incorporate that analysis by reference.

(xxxi) *'905 Patent, [49] "An optical add-drop apparatus, comprising"*

275. I previously analyzed Tew '640 in view of the following limitations:

- "[a]n optical add-drop apparatus[,]" discussed above in Section IX.1.a.ii (Paragraphs 186-189).

I incorporate that analysis by reference.

(xxxii) *'905 Patent, [49-a] "a fiber collimator serving as an input port for an input multi-wavelength optical signal having multiple spectral channels"*

276. I previously analyzed Tew '640 in view of the following limitations:

- "fiber collimators serving as an input port . . . [,]" discussed above in Section IX.1.a.ii (Paragraphs 186-189); and
- "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels[,]" discussed above in Section IX.1.a.iii (Paragraphs 190-192).

I incorporate that analysis by reference.

(xxxiii) *'905 Patent, [49-b] "an output port for an output multi-wavelength optical signal"*

277. I previously analyzed Tew '640 in view of the following limitations:

- "an output port . . . ," discussed above in Section IX.1.a.ii (Paragraphs 186-189); and
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.a.v (Paragraphs 197-199).

I incorporate that analysis by reference.

(xxxiv) *'905 Patent, [49-c] "one or more fiber collimators serving as one or more add ports for selected spectral channels to be added to said output multi-wavelength optical signal"*

278. I previously analyzed Tew '640 in view of the following limitations:

- "fiber collimators serving as . . . one or more other ports . . . ," discussed above in Section IX.1.a.ii (Paragraphs 186-189);

- "direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.a.xii (Paragraphs 226-228); and
- "wherein said fiber collimator one or more other ports comprise a fiber collimator add port . . for respectively adding second . . . spectral channels[,]" discussed above in Section IX.1.a.xv (Paragraphs 236-239).

I incorporate that analysis by reference.

(xxxv) *'905 Patent, [49-d] "a wavelength-selective device for reflecting said multiple and said selected spectral channels"*

279. I previously analyzed Tew '640 in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.a.vi (Paragraphs 200-202).

I incorporate that analysis by reference.

280. Tew '640 discloses to a POSITA "a wavelength-selective device for spatially separating said spectral channels."

281. Tew '640 discloses a beam separator that can separate light from an input fiber into multiple separated beams of light. For example, In Figure 10, reprinted below, "[a]s shown in Figure 10 (reprinted below), "light from an input fiber 1000 is collimated by an optic 1002 and strikes a beam separator such as diffraction grating 1004. The diffraction grating spatially separates the component beams of the input light beam. The component beams are directed by a second focusing optic 1006 to the mirror array 1008. As discussed above, the mirror array selectively directs the beams to one of at least two output fibers." Tew '640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23. That is, the mirror array can reflect the separated beams of light, for example, to an output fiber or a drop fiber.

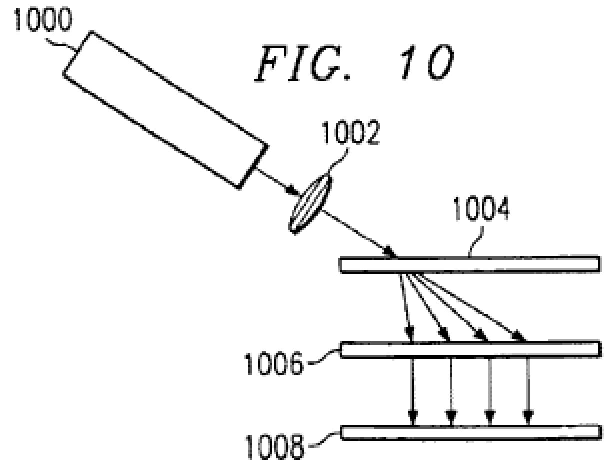


FIG. 10

Tew ’640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10. Additionally, in Figure 11 (reprinted below) the light separated from by the beam separator (diffraction grating 1004) can be individually captured by a number of fibers, such as the input fiber or add fiber as seen in Figures 4-8. For example, "[t]he separated beams are then individually captured by a set of optical fibers 1010. The optical fibers 1010 re-emit the separated light beams to the mirror array 1008." Tew ’640 at 10:44-50; *see also* Provisional Application No. 60/236,532 at 20:1-5.

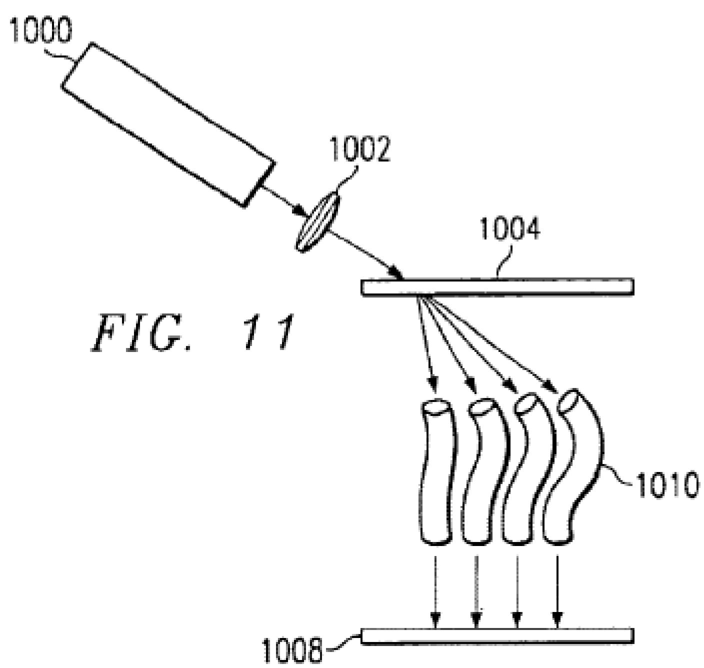


FIG. 11

Tew ’640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11.

282. Therefore, Tew ’640 discloses to a POSITA "a wavelength-selective device for spatially separating said spectral channels." Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(xxxvi)** *’905 Patent, [49-e] “a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports and to control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port, whereby said spectral channels from said fiber collimators serving as said add ports are selectively provided to said output port”*

283. I previously analyzed Tew ’640 in view of the following limitations:

- “a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]” discussed above in Section IX.1.a.vii (Paragraphs 203-214);

- “direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]” discussed above in Section IX.1.a.xii (Paragraphs 226-228); and

- “wherein said fiber collimator one or more other ports comprise a fiber collimator add port . . for respectively adding second . . . spectral channels[,]” discussed above in Section IX.1.a.xv (Paragraphs 236-239).

I incorporate that analysis by reference.

(xxxvii) *'905 Patent, [50] "The optical add-drop apparatus of claim 49, wherein none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"*

284. I previously analyzed Tew '640 in view of the following limitations:

- "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]" discussed above in Section IX.1.a.xix (Paragraphs 255-256).

I incorporate that analysis by reference.

(xxxviii) *'905 Patent, [51-pre] "A method of performing dynamic add and drop in a WDM optical network, comprising"*

285. I previously analyzed Tew '640 in view of the following limitations:

- "[a]n optical add-drop apparatus[,]" discussed above in Section IX.1.a.ii (Paragraphs 186-189);
- "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.a.xi (Paragraphs 223-225); and
- "the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.a.xii (Paragraphs 226-228).

I incorporate that analysis by reference.

286. To the extent the language in the preamble is considered limiting, Tew '640 discloses to a POSITA "a method of performing dynamic add and drop in a WDM optical network."

287. Tew '640 discloses steps for using an OADM. For example, "An optical switch ideally suited for use as an optical add drop multiplexer (OADM). A light beam entering the OADM through a first input fiber (402) is separated by wavelength to yield multiple light

beams (902, 904). One light beam (902) is reflected by one or more of the mirrors in mirror array (908). Depending on the position of the mirrors struck by light beam (902), the beam is reflected to a first region of a retro-reflector (910) or a second region (912). When light beam (902) is reflected by the second region (912) of the retro-reflector, it again travels to the mirror array (908) and is then reflected to a wavelength combiner (914) and output on the second ("drop") output fiber (408). While a first wavelength light beam (902) is reflected to the drop output (408), other wavelengths of light from the first input (402), for example light beam (904), are directed to the "out" optical fiber (406). A first group of mirrors (914) in the array (908) are thus used selectively to switch various wavelengths of the input optical signal to either the "out" optical fiber (406) or the "drop" optical fiber (408). Another group of mirrors (914) works cooperatively with the first group to direct light beams destined for the "drop" output fiber (408) to the wavelength combiner associated with the "drop" output. Other groups of mirrors operate to switch various wavelengths from the second input (404), the "add" fiber, to the first output "out."" Tew '640 at Abstract; *see also* Provisional Application No. 60/236,532 at Abstract.

288. Therefore, Tew '640 discloses to a POSITA "a method of performing dynamic add and drop in a WDM optical network, comprising." Even if Tew '640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxxix) *'905 Patent, [51-a] "separating an input multi-wavelength optical signal into spectral channels"*

289. I previously analyzed Tew '640 in view of the following similar limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.a.vi (Paragraphs 200-202).

I incorporate that analysis by reference.

(xl) *'905 Patent, [51-b] "imaging each of said spectral channels onto a corresponding beam-deflecting element"*

290. I previously analyzed Tew '640 in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channel[,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214); and
- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.a.xvi (Paragraphs 240-243).

I incorporate that analysis by reference.

(xli) *'905 Patent, [51-c] "controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal"*

291. I previously analyzed Tew '640 in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.a.viii (Paragraphs 215-217);
- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.a.ix (Paragraphs 218-221); and
- "said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal[,]" discussed above in Section IX.1.a.xiv (Paragraphs 233-235) and

I incorporate that analysis by reference.

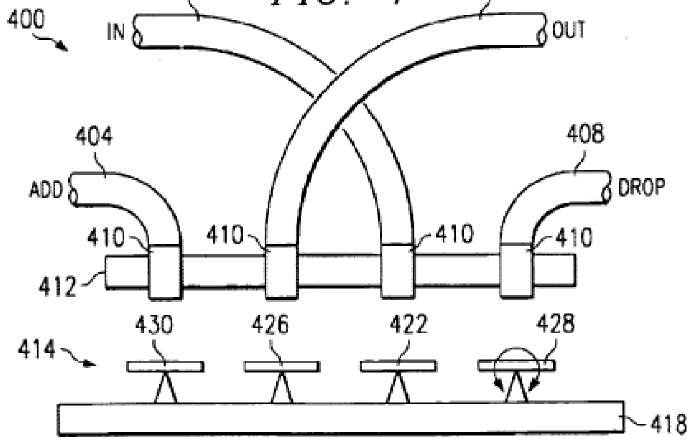
292. Tew ’640 discloses to a POSITA “controlling dynamically … said beam-deflecting elements.”

293. Tew ’640 discloses an array of mirrors that can be controlled to receive and transmit an optical signal. For example, a first group of mirrors (914) in the array (908) are thus used selectively to switch various wavelengths of the input optical signal to either the "out" optical fiber (406) or the "drop" optical fiber (408). Another group of mirrors (914) works cooperatively with the first group to direct light beams destined for the "drop" output fiber (408) to the wavelength combiner associated with the "drop" output. Other groups of mirrors operate to switch various wavelengths from the second input (404), the "add" fiber, to the first output "out."” Tew ’640 at Abstract; *see also id.* at 4:66-5:3; Provisional Application No. 60/236,532 at Abstract, 9:12-14 (“The switch of FIG. 2 is typically called an optical add drop multiplexer (OADM). It is used in optical networks to pass a received signal along the network, add a new signal to the transmission stream, or drop a signal from the transmission stream.”).

294. Tew ’640 discloses the micromirrors or deflecting members being moveable to direct the light beams. The micromirrors or deflecting members (reference numbers 422, 426, 428, and 430) can move and change positions to deflect the light beam from one port to either the output fiber or the drop fiber, as seen in the various embodiments shown in Figures 4-8, reprinted below. For example, “FIG. 6 is a side view of the OADM of FIG. 4 showing a second switch position used to add and drop signals. In FIG. 6, the first mirror 422 is rotated clockwise to a second position. In the second position, the first mirror 422 reflects light beam 420 from the first input fiber 402 to a second point or region 432 on the holding block 412. From the second region 432, the light beam 420 travels to a second mirror 428 and is reflected to the second

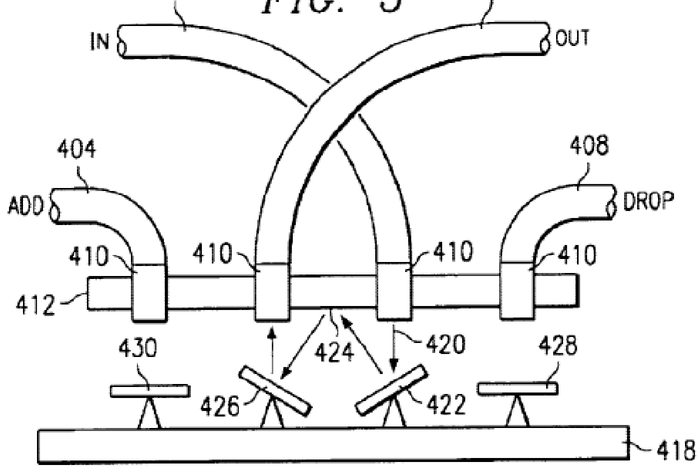
output fiber 408, the "drop" fiber." Tew '640 at 8:56-64; *see also* Provisional Application No. 60/236,532 at 16:17-22.

FIG. 4

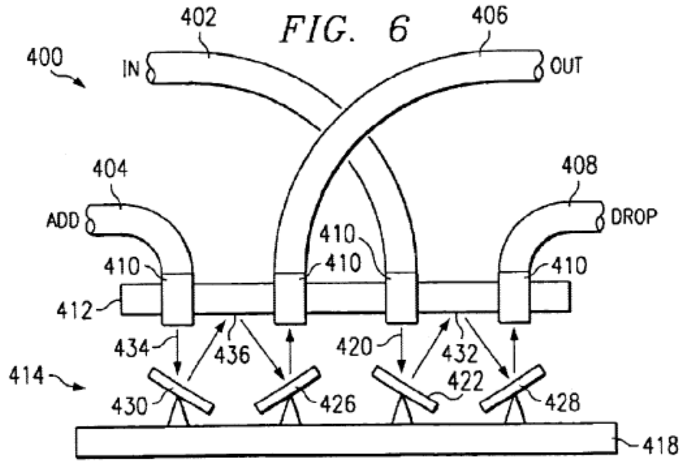


Tew '640 at FIG. 4; *see also* Provisional Application No. 60/236,532 at FIG. 4.

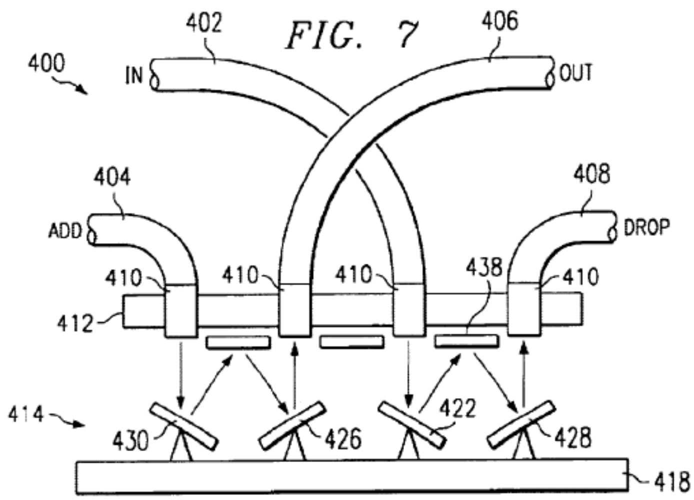
FIG. 5



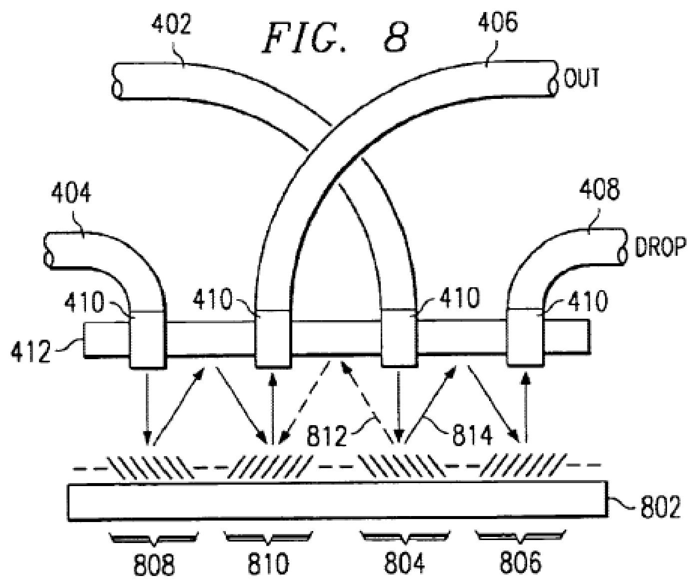
Tew '640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.



Tew ’640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

295. Therefore, Tew ’640 discloses to a POSITA “controlling dynamically . . . said beam deflecting elements.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xlii) *’905 Patent, [51-d] “receiving the output multi-wavelength optical signal at an output port that transmits the output multi-wavelength optical signal to an optical fiber; and wherein”*

296. I previously analyzed Tew ’640 in view of the following limitations:

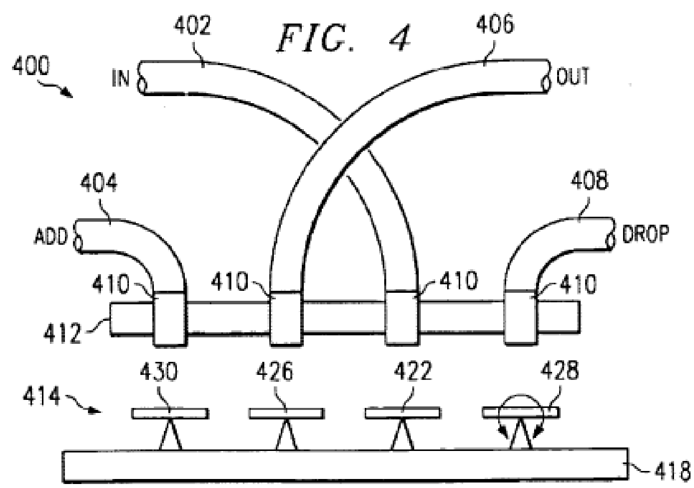
- “an output port[,]” discussed above in Section IX.1.a.ii (Paragraphs 186-189);
- “the output port for an output multi-wavelength optical signal[,]” discussed above in Section IX.1.a.v (Paragraphs 197-199); and
- “each of said elements . . . reflect[ing] its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]” discussed above in Section IX.1.a.vii (Paragraphs 203-214).

I incorporate that analysis by reference.

297. Tew '640 discloses to a POSITA "an output port that transmits the output multi-wavelength optical signal to an optical fiber."

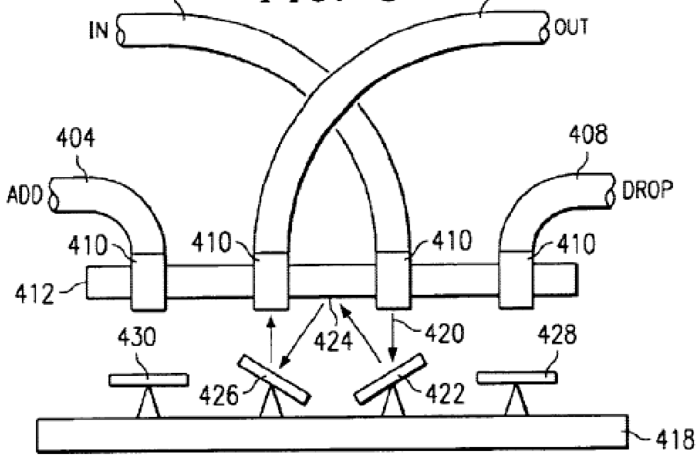
298. Tew '640 discloses a ferrule (reference number 410) that aligns the signal to the fiber. For example, "[e]ach fiber preferably is coupled to a focusing optic, typically a gradient index lens, designed to control dispersion of the light exiting the fiber. The focusing optic typically is held in a ferrule 410." Tew '640 at 8:23-28; *see also* Provisional Application No. 60/236,532 at 15:18-22. That is, the input fiber, the add fiber, the output fiber, and the drop fiber each have a "focusing optic typically … held in a ferrule 410. The ferrule 410 aligns the fiber with the focusing optic and provides a means to attach the fiber to a holding block 412." Tew '640 at 8:23-28; *see also* Provisional Application No. 60/236,532 at 15:18-22. The ferrule, which can act as a point of entry and exit for the optical signal, can be seen in Figures 4-8 (reprinted below).

FIG. 4



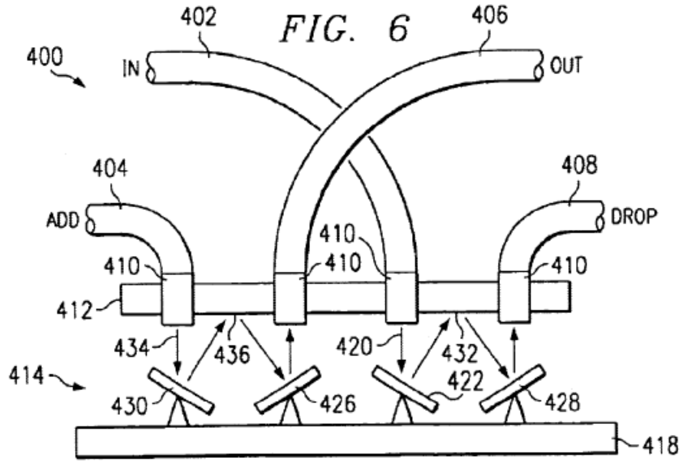
Tew '640 at FIG. 4; *see also* Provisional Application No. 60/236,532 at FIG. 4.

FIG. 5

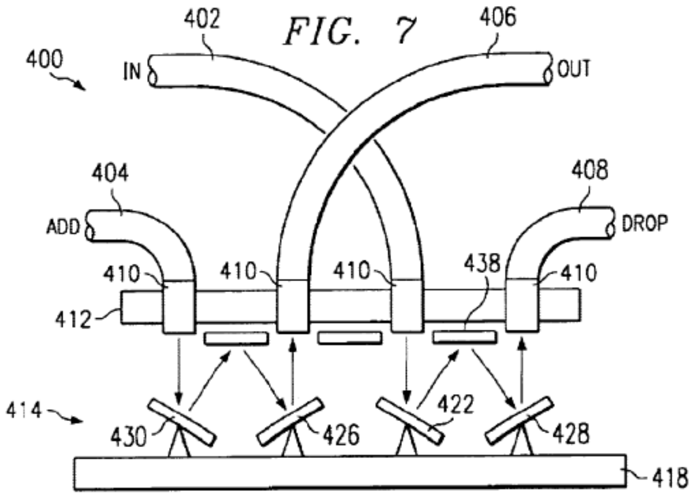


Tew ’640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.

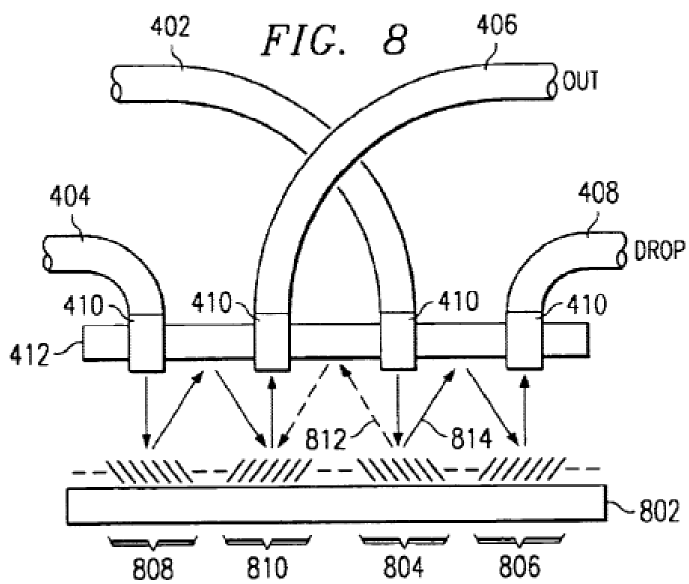
FIG. 6



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.



Tew ’640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

299. Therefore, Tew ’640 discloses to a POSITA “an output port that transmits the output multi-wavelength optical signal to an optical fiber.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xliii) *'905 Patent, [51-e] "said selected ones of said spectral channels comprises a subset of said spectral channels, such that other non-selected ones of said spectral channels are dropped from said output multi-wavelength optical signal; and"*

300. I previously analyzed Tew '640 in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214);
- "direct[ing] selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.a.xi (Paragraphs 223-225); and
- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.a.xv (Paragraphs 236-239).

I incorporate that analysis by reference.

(xliv) *'905 Patent, [51-f] "said controlling comprises reflecting said non-selected ones of said spectral channels to one or more fiber collimator serving as drop ports"*

301. I previously analyzed Tew '640 in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.a.viii (Paragraphs 215-217);
- "direct[ing] selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.a.xi (Paragraphs 223-225); and
- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.a.xv (Paragraphs 236-239).

I incorporate that analysis by reference.

(xlv) *'905 Patent, [52] "The method of claim 51 further comprising imaging other spectral channels onto other corresponding beam-deflecting elements, and controlling dynamically and continuously said other beam-deflecting elements so as to combine said other spectral channels with said selected ones of said spectral channels into said output multi-wavelength optical signal"*

302. I previously analyzed Tew '640 in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.a.viii (Paragraphs 215-217);
- "direct[ing] selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.a.xii (Paragraphs 226-228); and
- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.a.xv (Paragraphs 236-239).
- "controlling dynamically . . . beam-deflecting elements[,]" discussed above in Section IX.1.a.xli (Paragraphs 291-295).

I incorporate that analysis by reference.

(xlvi) *'905 Patent, [53] "The method of claim 51, wherein said imaging comprises focusing said spectral channels onto said beam-deflecting elements"*

303. I previously analyzed Tew '640 in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels[,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214); and
- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.a.xvi (Paragraphs 240-243).

I incorporate that analysis by reference.

(xlvii) *'905 Patent, [54] "The method of claim 51 further comprising monitoring a power level in one or more of said selected ones of said spectral channels, and controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring"*

304. I previously analyzed Tew '640 in view of the following limitations:

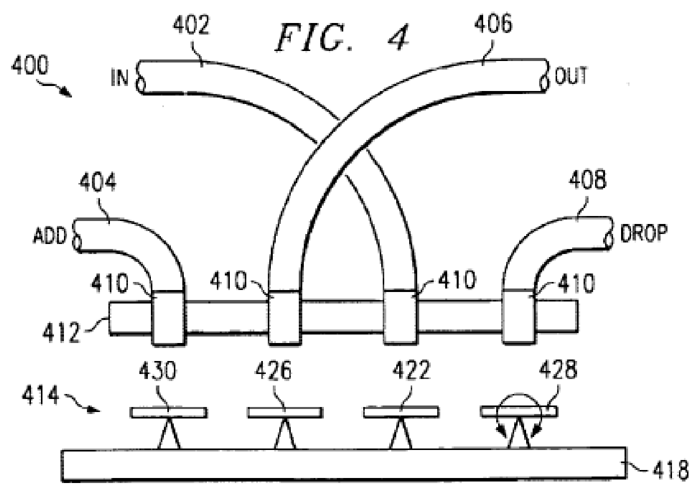
- "a spectral monitor for monitoring said power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.a.ix (Paragraphs 218-221).

I incorporate that analysis by reference.

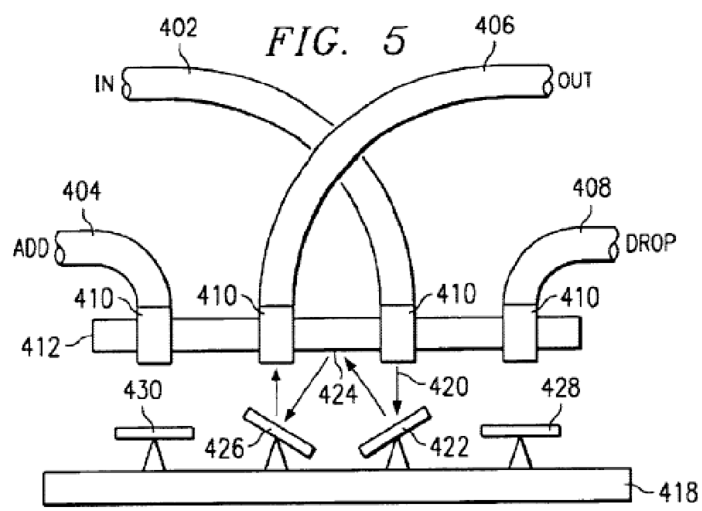
305. Tew '640 discloses mirrors that can be shaped to help focus the light form one fiber or mirror to the next, thus simplifying the alignment of the OADM. For example, "in some applications using a spherical or aspherical curved deflecting surface helps to focus the light from one fiber or mirror to the next, or helps to simplify alignment of the OADM during assembly." Tew '640 at 11:27-41; *see also* Provisional Application No. 60/236,532 at 21:11-19.

306. Figures 4-7 of Tew '640 , reprinted below, disclose mirrors assigned to each fiber, positioned to receive light from one of the input fibers and transmit light to one of the output fibers. For example, one mirror can receive light from an input fiber (reference numbers 422 and 402, respectively), another mirror can receive light from an add fiber (reference numbers 430 and 404, respectively), another mirror can transmit light to an output fiber (reference numbers 426 and 406, respectively), and another mirror can transmit light to a drop fiber (reference numbers 428 and 408, respectively). For example, "[i]n FIG. 6, the first mirror 422 is rotated clockwise to a second position. In the second position, the first mirror 422 reflects light beam 420 from the first input fiber 402 to a second point or region 432 on the holding block 412. From the second region 432, the light beam 420 travels to a second mirror 428 and is reflected to the second output fiber 408, the "drop" fiber." Tew '640 at 8:56-64; *see also*

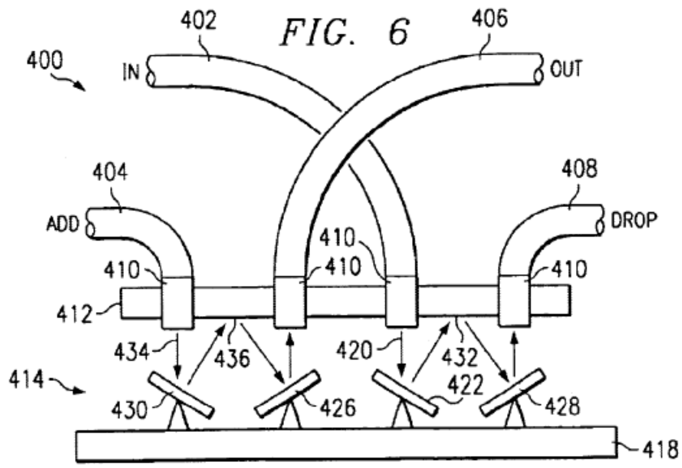
Provisional Application No. 60/236,532 at 16:17-22. As another example, "[t]he second light beam 434 exits the second input fiber 404, the "add" fiber, and is reflected by a third mirror 430 to a third point or region 436 on the holding block 412. From the third region 436, the light travels to the fourth mirror 426 which, when in a second position shown in FIG. 6 (rotated counterclockwise), directs the second light beam 434 to the first output fiber 406." Tew ’640 at 8:67-9:6; *see also* Provisional Application No. 60/236,532 at 17:2-6.



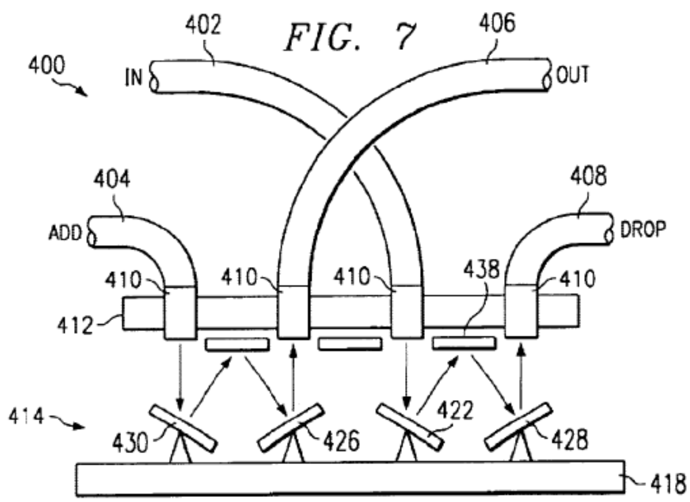
Tew ’640 at FIG. 4; *see also* Provisional Application No. 60/236,532 at FIG. 4.



Tew ’640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



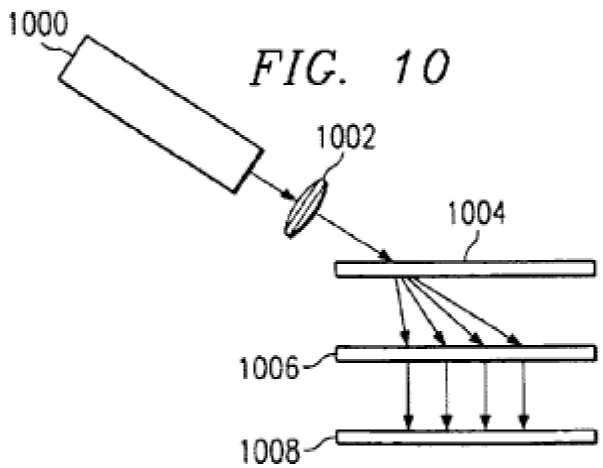
Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.

(xlviii) *’906 Patent, [68-pre] “A wavelength-separating-routing apparatus, comprising”*

307. To the extent the language in the preamble is considered limiting, Tew ’640 discloses to a POSITA “a wavelength-separating-routing apparatus.”

308. Tew ’640 discloses a wavelength-separating-routing apparatus. For example, “[a] light beam entering the OADM through a first input fiber (402) is separated by wavelength to yield multiple light beams (902, 904).” Tew ’640 at Abstract; *see also* Provisional Application

No. 60/236,532 at Abstract. Further, Figure 10, reprinted below, "light from an input fiber 1000 is collimated by an optic 1002 and strikes a beam separator such as diffraction grating 1004. The diffraction grating spatially separates the component beams of the input light beam" (emphasis added). Tew '640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23.



Tew '640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10. Additionally, in Figure 11, reprinted below, the light separated from by the beam separator (diffraction grating 1004) can be individually captured by a number of fibers. For example, "[t]he separated beams are then individually captured by a set of optical fibers 1010. The optical fibers 1010 re-emit the separated light beams to the mirror array 1008." Tew '640 at 10:44-50; *see also* Provisional Application No. 60/236,532 at 20:1-5.

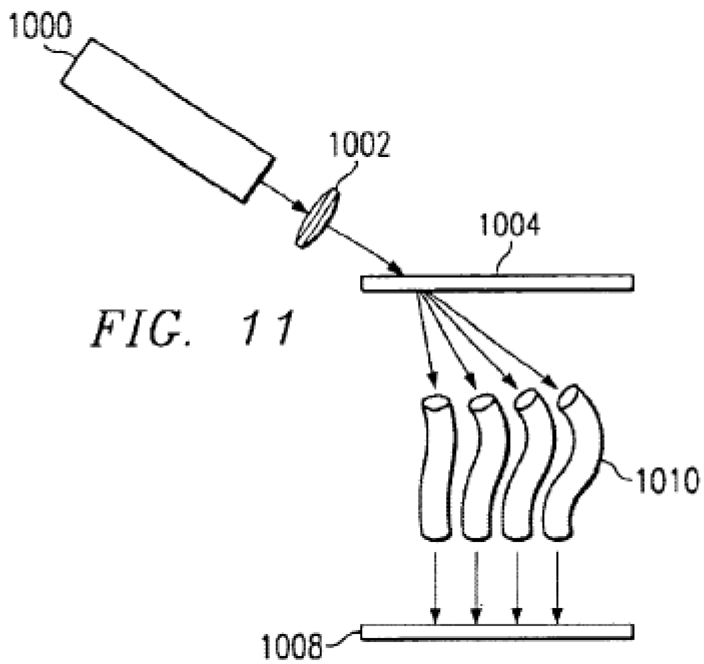


FIG. 11

Tew ’640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11.

309. Therefore, Tew ’640 discloses to a POSITA “a wavelength-separating-routing apparatus.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xlix) *’906 Patent, [68-a] “multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports”*

310. I previously analyzed Tew ’640 in view of the following limitations:

- “an output port and fiber collimators serving as an input port and one or more other ports[,]” discussed above in Section IX.1.a.iii (Paragraphs 190-192).

I incorporate that analysis by reference.

311. Under Capella’s apparent construction, Tew ’640 discloses to a POSITA “multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports.”

312. The output port can be a fiber collimator port. Components such as fiber collimators can be added to different portions of the embodiments, as would suit the optical designer. For example, "focusing optics may be added between the input fibers and the wavelength separators, between the wavelength combiners 914 and the output fibers, and between the mirror array 908 and separators 906 or combiners 914. Furthermore, although shown as separate separators 906 and combiners 914, it should be understood that other configurations are intended by this disclosure." Tew '640 at 10:21-34; *see also* Provisional Application No. 60/236,532 at 19:9-17. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

313. Therefore, under Capella's apparent interpretation, Tew '640 discloses to a POSITA "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports." Even if Tew '640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(l) *'906 Patent, [68-b] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

314. I previously analyzed Tew '640 in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.a.vi (Paragraphs 200-202).

I incorporate that analysis by reference.

(li) *'906 Patent, [68-c] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

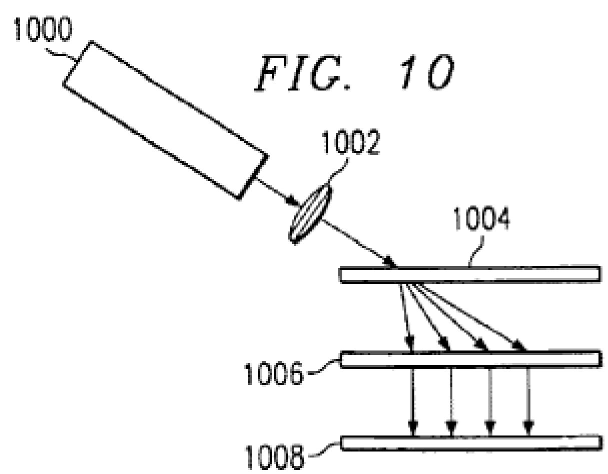
315. I previously analyzed Tew '640 in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.a.xvi (Paragraphs 240-243).

I incorporate that analysis by reference.

316. Tew '640 discloses to a POSITA that the channels are focused onto corresponding spectral spots.

317. Tew '640 discloses a beam focuser that directs light beams to the mirror array. For example, "[t]he component beams are directed by a second focusing optic 1006 to the mirror array 1008. As discussed above, the mirror array selectively directs the beams to one of at least two output fibers." Tew '640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23. Figure 10 is reprinted below.



Tew '640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10.

318. As another example, "[i]n FIG. 11, light from the input fiber 1000 again is focused onto a beam separator such as diffraction grating 1004 by a focusing optic 1002. The separated beams are then individually captured by a set of optical fibers 1010[,]" which as discussed previously, the optical fibers (as seen in Figures 4-8, for example) can direct to the

mirrors. Tew ’640 at 10:44-56; *see also* Provisional Application No. 60/236,532 at 20:1-9. Figure 11 is reprinted below.

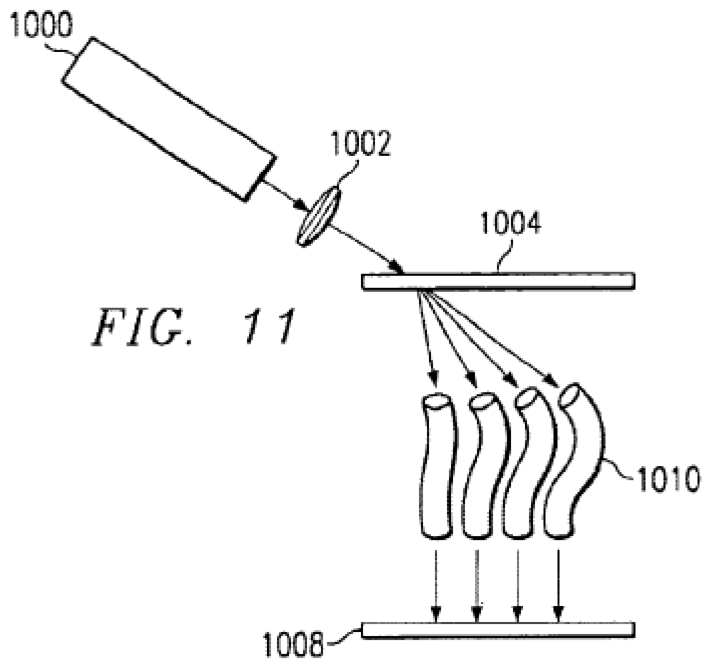


FIG. 11

Tew ’640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11.

319. Therefore, Tew ’640 discloses to a POSITA that the channels are focused onto corresponding spectral spots. Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lii) *’906 Patent, [68-d] “a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports”*

320. I previously analyzed Tew ’640 in view of the following limitations:

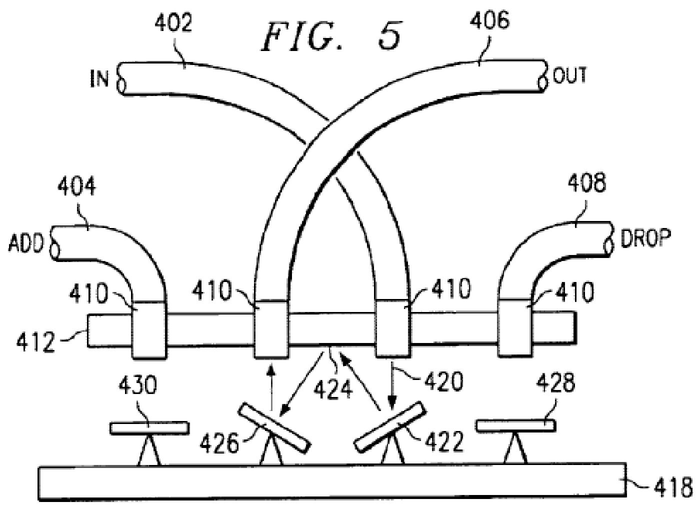
- “a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of

> said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port [,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214).

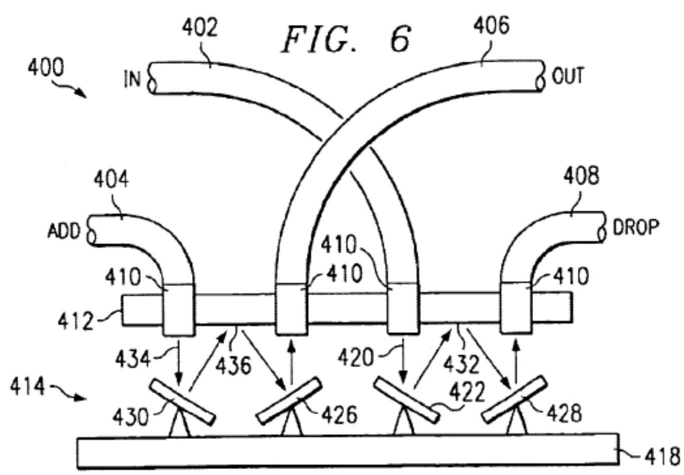
I incorporate that analysis by reference.

321. Tew '640 discloses "channel micromirrors." To the extent Tew '640 does not teach "pivotal about two axes[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

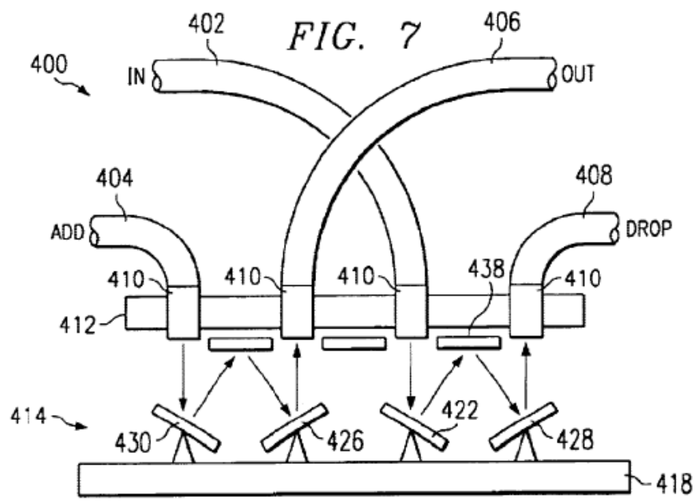
322. Tew '640 discloses micromirrors placed to either receive an input signal from an input fiber or an add fiber, or transmit an output signal to an output fiber or a drop fiber. For example, "[t]he micromirror array 414 of FIG. 4 includes four discrete mirrors 416. Each of the mirrors 422, 426, 428, 430 is operable to tilt clockwise or counterclockwise about an axis perpendicular to the plane of FIG. 4." Tew '640 at 8:32-40; *see also* Provisional Application No. 60/236,532 at 16:1-6. As another example, "[i]n FIG. 6, the first mirror 422 is rotated clockwise to a second position. In the second position, the first mirror 422 reflects light beam 420 from the first input fiber 402 to a second point or region 432 on the holding block 412. From the second region 432, the light beam 420 travels to a second mirror 428 and is reflected to the second output fiber 408, the "drop" fiber." Tew '640 at 8:56-64; *see also* Provisional Application No. 60/236,532 at 16:17-22. Figures 5-7, replicated below, show the mirrors (reference numbers 422, 424, 428, and 430) either receiving or transmitting the signals.



Tew ’640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.

323. Therefore, Tew ’640 discloses to a POSITA “channel micromirrors.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Tew ’640 does not teach “pivotal about two axes[,]” these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(liii) *’906 Patent, [69] “The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports”*

324. I previously analyzed Tew ’640 in view of the following limitations:

- “a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]” discussed above in Section IX.1.a.ix (Paragraphs 218-221);
- “wherein said servo-control assembly maintains said power levels at predetermined values[,]”discussed above in Section IX.1.a.x (Paragraph 222); and

- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.a.xxii (Paragraph 262).

I incorporate that analysis by reference.

325. To the extent Tew '640 does not teach "in communication with said channel micromirrors and said fiber collimator output ports" and "maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(liv) *'906 Patent, [70] "The wavelength-separating-routing apparatus of claim 69 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

326. I previously analyzed Tew '640 in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.a.ix (Paragraphs 218-221).

I incorporate that analysis by reference.

327. To the extent Tew '640 does not teach "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lv) *'906 Patent, [71] "The wavelength-separating-routing apparatus of claim 70 wherein said servo-control assembly maintains said power levels at a predetermined value."*

328. I previously analyzed Tew '640 in view of the following limitations:

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]" discussed above in Section IX.1.a.x (Paragraph 222).

I incorporate that analysis by reference.

(lvi) *'906 Patent, [72] "The wavelength-separating-routing apparatus of claim 68 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."*

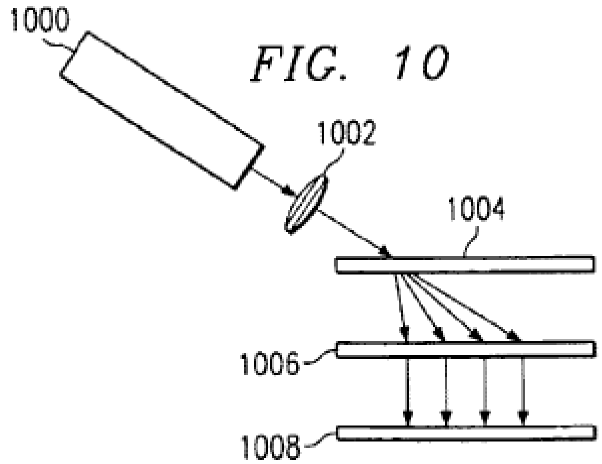
329. I previously analyzed Tew '640 in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.a.xiii (Paragraphs 229-232); and

- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.a.xlvii (Paragraphs 304-306).

I incorporate that analysis by reference.

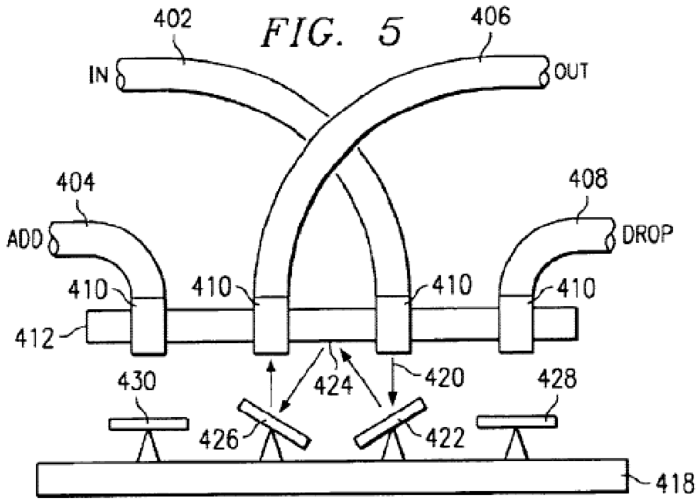
330. Tew '640 discloses the a signal from an input fiber being collimated and separated by wavelength before striking a mirror array 1008. For example, in "FIG. 10, light from an input fiber 1000 is collimated by an optic 1002 and strikes a beam separator such as diffraction grating 1004." Tew '640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23.



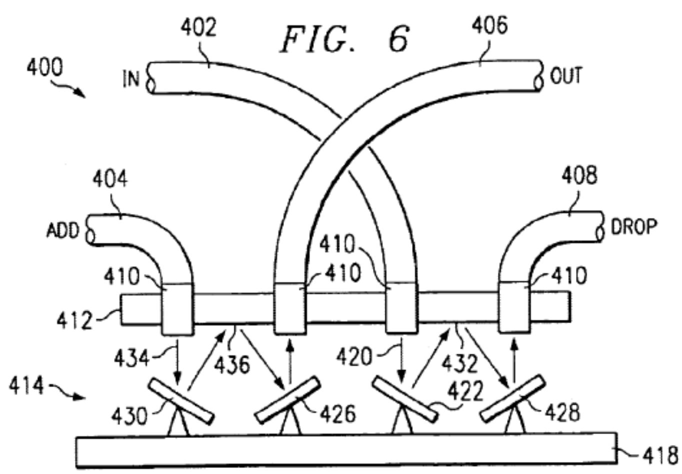
Tew ’640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10. Additionally, Tew ’640 discloses having a first input fiber providing a signal and a second input fiber (such as the "add" fiber to provide an additional signal), and a first output fiber to receive the signal and a second output fiber (such as the "drop" fiber to drop a signal). For example, in "FIG. 4, the OADM 400 has two inputs and two outputs. A first input fiber 402 provides an optical signal to the OADM 400. This first input fiber 402, the "in" fiber, typically provides signals from remote portions of an optical network. A second input 404, the "add" fiber, allows a local signal to be transmitted by the network. The two output fibers include a first output 406, typically connected to the rest of the network, and a second output 408, typically used to deliver a signal to local equipment." Tew ’640 at 8:14-22; *see also* Provisional Application No. 60/236,532 at 15:12-17.

331. Tew ’640 discloses micromirrors placed to either receive an input signal from the input fiber or an add fiber, and transmit an output signal to an output fiber or a drop fiber. For example, "[t]he micromirror array 414 of FIG. 4 includes four discrete mirrors 416. Each of the mirrors 422, 426, 428, 430 is operable to tilt clockwise or counterclockwise about an axis perpendicular to the plane of FIG. 4." Tew ’640 at 8:32-40; *see also* Provisional Application No. 60/236,532 at 16:1-6. As another example, "[i]n FIG. 6, the first mirror 422 is rotated

clockwise to a second position. In the second position, the first mirror 422 reflects light beam 420 from the first input fiber 402 to a second point or region 432 on the holding block 412. From the second region 432, the light beam 420 travels to a second mirror 428 and is reflected to the second output fiber 408, the "drop" fiber." Tew '640 at 8:56-64; *see also* Provisional Application No. 60/236,532 at 16:17-22. Figures 5-7, replicated below, show the mirrors (reference numbers 422, 424, 428, and 430) either receiving or transmitting the signals.

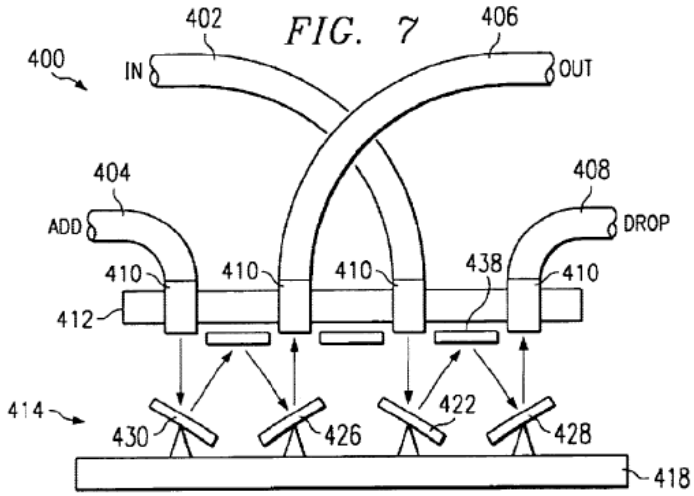


Tew '640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.



Tew '640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.

FIG. 7



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7. Thus, the mirrors are in optical communication with the wavelength-separators and fiber collimator input and output ports, and the mirrors direct the reflected channels into the output ports.

> **(lvii)** *’906 Patent, [79] “The wavelength-separating-routing apparatus of claim 68 wherein each channel micromirror is a silicon micromachined mirror.”*

332. Tew ’640 discloses to a POSITA “wherein each channel micromirror is a silicon micromachined mirror.”

333. Tew ’640 discloses the mirrors being silicon micromachined mirrors. For example, “[t]he mirrors are silicon, gold, aluminum, or other metals or materials capable of reflecting the signal energy in the wavelengths transmitted by the switch. If the mirrors are sufficiently large, a single mirror is used to reflect each signal. Alternatively, a number of small mirrors are used to collectively reflect the each signal.” Tew ’640 at 5:19-32; *see also* Provisional Application No. 60/236,532 at 10:3-11; Tew ’640 at 55-56 (“The micromirror 300 is fabricated on a semiconductor, typically silicon, substrate 304.”).

334. Therefore, Tew ’640 discloses to a POSITA “wherein each channel micromirror is a silicon micromachined mirror.” Even if Tew ’640 does not do so, however, these limitations

would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lviii) *'906 Patent, [80] "The wavelength-separating-routing apparatus of claim 68 wherein said fiber collimator input and output ports are arranged in a one-dimensional array."*

335. I previously analyzed Tew '640 in view of the following limitations:

- "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array[,]"discussed above in Section IX.1.a.xx (Paragraphs 257-260).

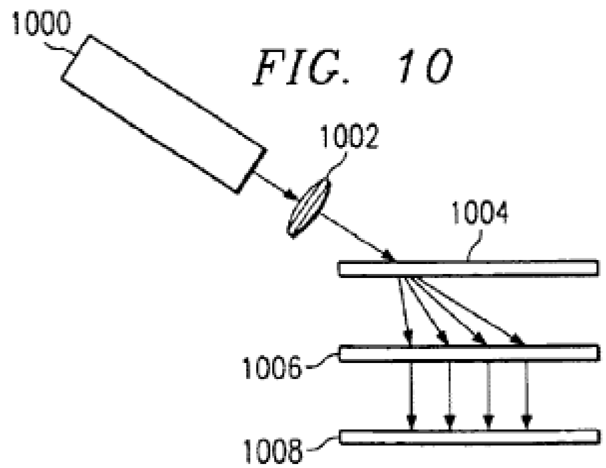
I incorporate that analysis by reference.

(lix) *'906 Patent, [81] "The wavelength-separating-routing apparatus of claim 68 wherein said beam-focuser comprises a focusing lens having first and second focal points."*

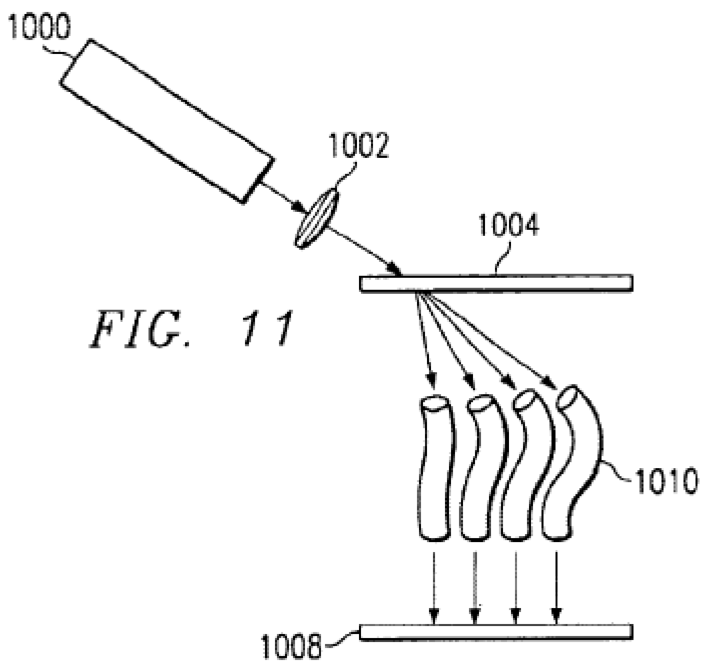
336. Tew '640 discloses to a POSITA "wherein said beam-focuser comprises a focusing lens having first and second focal points."

337. Tew '640 discloses focusing optics, such as gradient lenses, to control dispersion of light exiting a fiber. *See* Tew '640 at 8:23-25; *see also* Provisional Application No. 60/236,532 at 15:18-19. The "focusing optics may be added between the input fibers and the wavelength separators, between the wavelength combiners 914 and the output fibers, and between the mirror array 908 and separators 906 or combiners 914." Tew '640 at 10:21-34; *see also* Provisional Application No. 60/236,532 at 19:9-17. The focusing optics can be used to focus a beam onto multiple points, as shown in Figures 10-11 (reprinted below). For example, "light from an input fiber 1000 is collimated by an optic 1002 and strikes a beam separator such as diffraction grating 1004. The diffraction grating spatially separates the component beams of the input light beam. The component beams are directed by a second focusing optic 1006 to the mirror array 1008." Tew '640 at 10:35-43; *see id.* at 10:44-56; *see also* Provisional Application No. 60/236,532 at 19:18-23, 20:1-9. ("In FIG. 11, light from the input fiber 1000 again is

focused onto a beam separator such as diffraction grating 1004 by a focusing optic 1002. The separated beams are then individually captured by a set of optical fibers 1010.")



Tew '640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10.



Tew '640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11.

338. Additionally, Tew '640 discloses mirrors that can be shaped to help focus the light form one fiber or mirror to the next, thus simplifying the alignment of the OADM. For example, "in some applications using a spherical or aspherical curved deflecting surface helps to

focus the light from one fiber or mirror to the next, or helps to simplify alignment of the OADM during assembly." Tew ’640 at 11:27-41; *see also* Provisional Application No. 60/236,532 at 21:11-19.

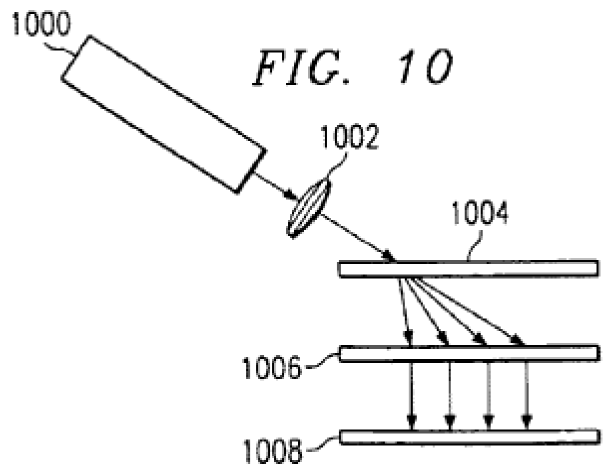
339. Therefore, Tew ’640 discloses to a POSITA “wherein said beam-focuser comprises a focusing lens having first and second focal points.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lx) *’906 Patent, [82] “The wavelength-separating-routing apparatus of claim 81 wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens.”*

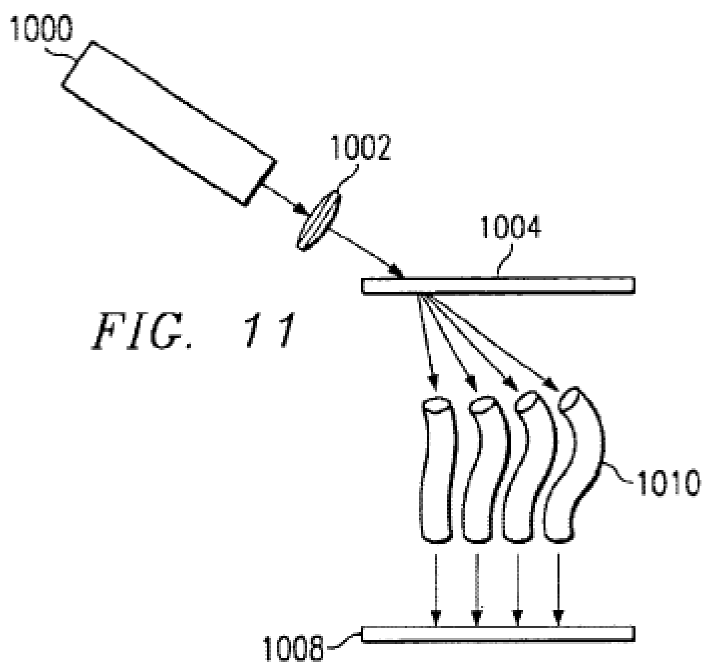
340. Tew ’640 discloses to a POSITA “wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens.”

341. Tew ’640 discloses focusing optics, such as gradient lenses, to control dispersion of light exiting a fiber. *See* Tew ’640 at 8:23-25; *see also* Provisional Application No. 60/236,532 at 15:18-19. The “focusing optics may be added between the input fibers and the wavelength separators, between the wavelength combiners 914 and the output fibers, and between the mirror array 908 and separators 906 or combiners 914.” Tew ’640 at 10:21-34; *see also* Provisional Application No. 60/236,532 at 19:9-17. A first focusing optic, such as the focusing optic 1002, can focus a beam onto a beam separator such as a diffraction grating 1004. The second focusing optic, such as the focusing optic 1006, can then focus the separated beams onto the mirror array 1008. As shown in Figures 10-11 (reprinted below), “light from an input fiber 1000 is collimated by an optic 1002 and strikes a beam separator such as diffraction grating 1004. The diffraction grating spatially separates the component beams of the input light

beam. The component beams are directed by a second focusing optic 1006 to the mirror array 1008." Tew '640 at 10:35-43; *see id.* at 10:44-56; *see also* Provisional Application No. 60/236,532 at 19:18-23, 20:1-9. ("In FIG. 11, light from the input fiber 1000 again is focused onto a beam separator such as diffraction grating 1004 by a focusing optic 1002. The separated beams are then individually captured by a set of optical fibers 1010.")



Tew '640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10.



Tew '640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11.

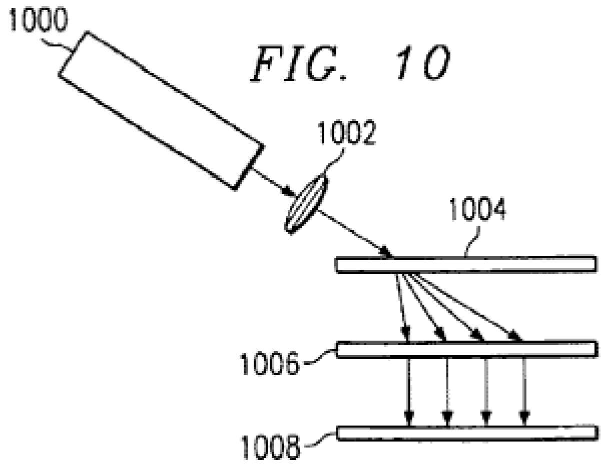
342. Therefore, Tew ’640 discloses to a POSITA “wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxi) *’906 Patent, [83] “The wavelength-separating-routing apparatus of claim 68 wherein said beam-focuser comprises an assembly of lenses.”*

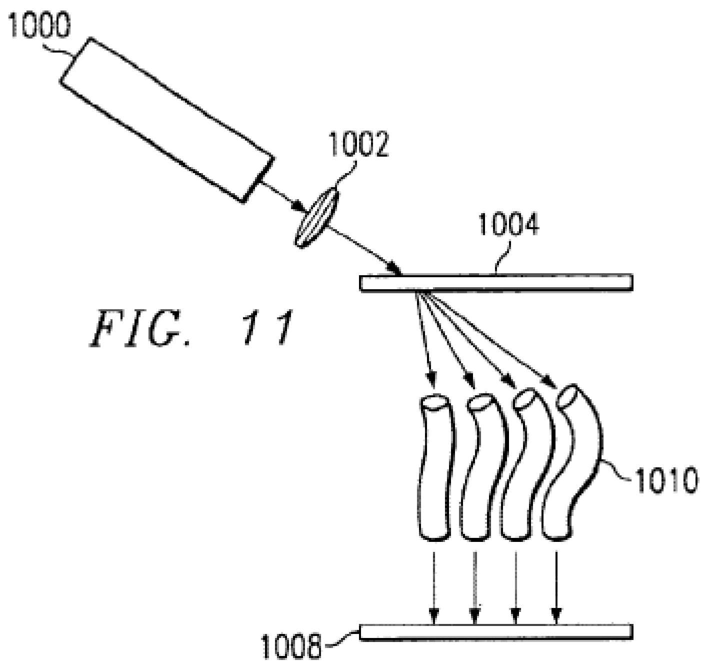
343. Tew ’640 discloses to a POSITA “wherein said beam-focuser comprises an assembly of lenses.”

344. Tew ’640 discloses focusing optics, such as gradient lenses, to control dispersion of light exiting a fiber. *See* Tew ’640 at 8:23-25; *see also* Provisional Application No. 60/236,532 at 15:18-19. The “focusing optics may be added between the input fibers and the wavelength separators, between the wavelength combiners 914 and the output fibers, and between the mirror array 908 and separators 906 or combiners 914.” Tew ’640 at 10:21-34; *see also* Provisional Application No. 60/236,532 at 19:9-17. A first focusing optic, such as the focusing optic 1002, can focus a beam onto a beam separator such as a diffraction grating 1004. The second focusing optic, such as the focusing optic 1006, can then focus the separated beams onto the mirror array 1008. As such, Tew ’640 discloses multiple focusing optics (which a POSITA would know could be lenses), thus Tew ’640 can comprise an assembly of lenses. As shown in Figures 10-11 (reprinted below), “light from an input fiber 1000 is collimated by an optic 1002 and strikes a beam separator such as diffraction grating 1004. The diffraction grating spatially separates the component beams of the input light beam. The component beams are directed by a second focusing optic 1006 to the mirror array 1008.” Tew ’640 at 10:35-43; *see id.* at 10:44-56; *see also* Provisional Application No. 60/236,532 at 19:18-23, 20:1-9. (“In FIG.

11, light from the input fiber 1000 again is focused onto a beam separator such as diffraction grating 1004 by a focusing optic 1002. The separated beams are then individually captured by a set of optical fibers 1010.")



Tew '640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10.



Tew '640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11.

345. Further, Tew '640 does not limit itself to a single focusing optic. "It is envisioned that various additional components will be used in some applications at the discretion of the

optical designer. For example, focusing optics may be added between the input fibers and the wavelength separators, between the wavelength combiners 914 and the output fibers, and between the mirror array 908 and separators 906 or combiners 914." Tew '640 at 10:21-34; *see also* Provisional Application No. 60/236,532 at 19:9-17.

346. Therefore, Tew '640 discloses to a POSITA "wherein said beam-focuser comprises an assembly of lenses." Even if Tew '640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxii) *'906 Patent, [84] "The wavelength-separating-routing apparatus of claim 68 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing gratings."*

347. I previously analyzed Tew '640 in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.a.xvii (Paragraphs 244-250).

I incorporate that analysis by reference.

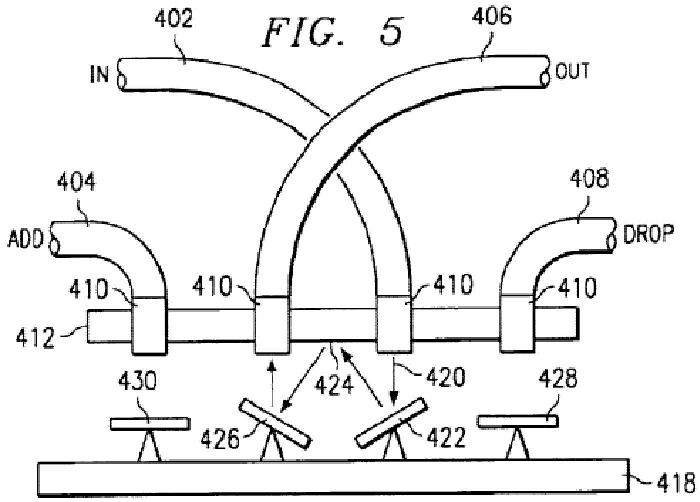
(lxiii) *'906 Patent, [85] "The wavelength-separating-routing apparatus of claim 68 further comprising a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors."*

348. To the extent Tew '640 does not teach "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

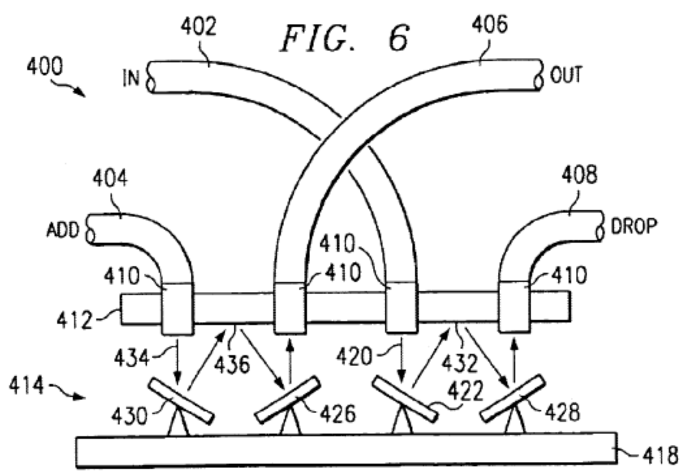
(lxiv) *'906 Patent, [86] "The wavelength-separating-routing apparatus of claim 68 wherein each fiber collimator output port carries a single one of said spectral channels."*

349. Under Capella's apparent interpretation, Tew '640 discloses to a POSITA "wherein each fiber collimator output port carries a single one of said spectral channels."

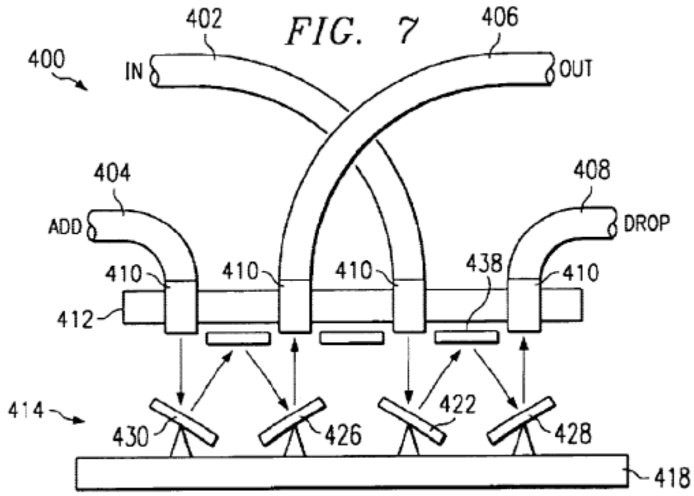
350. Tew '640 discloses each output port carrying one signal. For example, as shown in Figure 5, a single light beam such as "the light beam 420" is output by "the first output fiber 406 from the OADM. Thus, any signal received by the OADM on the first input fiber 402 passes through the OADM and exits the OADM on the first output fiber 406." Tew '640 at 8:44-55; *see also* Provisional Application No. 60/236,532 at 16:9-16. As shown in Figure 6, the "light beam 420 from the first input fiber 402 … is reflected to the second output fiber 408, the "drop" fiber. At the same time the light beam 420 from the "in" fiber 402 is being dropped, another light beam 434 is provided to the first output fiber 406. The second light beam 434 exits the second input fiber 404, the "add" fiber" Tew '640 at 8:57-9:1; *see also* Provisional Application No. 60/236,532 at 16:1-3. Figure 7 similarly shows the signal from the add fiber being output by the output fiber, while the signal from the input fiber is output by the drop fiber. The output fiber and the drop fiber each can carry a single signal. Figures 5-7 are reprinted below.



Tew ’640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.

351. Additionally, the output port can be a fiber collimator port. Components such as fiber collimators can be added to different portions of the embodiments, as would suit the optical designer. For example, “focusing optics may be added between the input fibers and the wavelength separators, between the wavelength combiners 914 and the output fibers, and between the mirror array 908 and separators 906 or combiners 914. Furthermore, although shown as separate separators 906 and combiners 914, it should be understood that other configurations are intended by this disclosure.” Tew ’640 at 10:21-34; *see also* Provisional Application No. 60/236,532 at 19:9-17. To the extent that “fiber collimator” port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a “fiber collimator” port in a single package.

352. Therefore, under Capella’s apparent interpretation, Tew ’640 discloses to a POSITA “wherein each fiber collimator output port carries a single one of said spectral channels.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxv) *'906 Patent, [87] "The wavelength-separating-routing apparatus of claim 86 further comprising one or more optical sensors, optically coupled to said fiber collimator output ports."*

353. To the extent Tew '640 does not teach "one or more optical sensors, optically coupled to said fiber collimator output ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxvi) *'906 Patent, [88] "The wavelength-separating-routing apparatus of claim 68, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator."*

354. I previously analyzed Tew '640 in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.a.xix (Paragraphs 255-256).

I incorporate that analysis by reference.

(lxvii) *'906 Patent, [89-pre] "A servo-based optical apparatus comprising"*

355. I previously analyzed Tew '640 in view of the following limitations:

- "An optical . . . apparatus[,]" discussed above in Section IX.1.a.ii (Paragraphs 186-189);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.a.viii (Paragraphs 215-217); and
- "wherein the control unit further comprises a servo-control assembly[,]" discussed above in Section IX.1.a.ix (Paragraphs 218-221).

I incorporate that analysis by reference.

(lxviii) *'906 Patent, [89-a] "multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports"*

356. I previously analyzed Tew '640 in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.a.ii (Paragraphs 186-189); and

- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports [,]" discussed above in Section IX.1.a.xlix (Paragraphs 310-313).

I incorporate that analysis by reference.

(lxix) *'"906 Patent, [89-b] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

357. I previously analyzed Tew '640 in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.a.vi (Paragraphs 200-202).

I incorporate that analysis by reference.

(lxx) *'906 Patent, [89-c] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

358. I previously analyzed Tew '640 in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.a.xvi (Paragraphs 240-243).

- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.a.li (Paragraphs 315-319).

I incorporate that analysis by reference.

(lxxi) *'906 Patent, [89-d] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said fiber collimator output ports"*

359. I previously analyzed Tew '640 in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two

dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.a.lii (Paragraphs 320-323).

I incorporate that analysis by reference.

(lxxii) *'906 Patent, [89-e] "a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports."*

360. I previously analyzed Tew '640 in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.a.ix (Paragraphs 218-221);

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.a.x (Paragraph 222);

- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.a.xxii (Paragraph 262); and

- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.a.liii (Paragraphs 324-325).

I incorporate that analysis by reference.

(lxxiii) *'906 Patent, [90] "The servo-based optical apparatus of claim 89 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

361. I previously analyzed Tew '640 in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.a.ix (Paragraphs 218-221); and

- "said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors[,]" discussed above in Section IX.1.a.liv (Paragraphs 326-327).

I incorporate that analysis by reference.

(lxxiv) *'906 Patent, [91] "The servo-based optical apparatus of claim 90 wherein said servo-control assembly maintains said power levels at a predetermined value"*

362. I previously analyzed Tew '640 in view of the following limitations:

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]" discussed above in Section IX.1.a.x (Paragraph 222); and

- "wherein said servo-control assembly maintains said power levels at a predetermined value[,]" discussed above in Section IX.1.a.lv (Paragraph 328).

I incorporate that analysis by reference.

(lxxv) *'906 Patent, [92] "The servo-based optical apparatus of claim 89 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."*

363. I previously analyzed Tew '640 in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.a.xiii (Paragraphs 229-232);

- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.a.xlvii (Paragraphs 304-306); and

- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.a.lvi (Paragraphs 329-331)

I incorporate that analysis by reference.

(lxxvi) *'906 Patent, [96] "The servo-based optical apparatus of claim 89 wherein each channel micromirror is a silicon micromachined mirror."*

364. I previously analyzed Tew '640 in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.a.lvii (Paragraphs 332-334).

I incorporate that analysis by reference.

(lxxvii) *'906 Patent, [97] "The servo-based optical apparatus of claim 89 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

365. I previously analyzed Tew '640 in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.a.xvii (Paragraphs 244-250).

I incorporate that analysis by reference.

(lxxviii) *'906 Patent, [98] "The servo-based optical apparatus of claim 89 wherein said beam-focuser comprises one or more lenses."*

366. I previously analyzed Tew '640 in view of the following limitations:

- "wherein said beam-focuser comprises an assembly of lenses [,]"discussed above in Section IX.1.a.lxi (Paragraphs 343-346).

I incorporate that analysis by reference.

(lxxix) *'906 Patent, [99] "The servo-based optical apparatus of claim 89, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"*

367. I previously analyzed Tew '640 in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.a.xix (Paragraphs 255-256).

I incorporate that analysis by reference.

(lxxx) *'906 Patent, [100-pre] "An optical apparatus comprising:"*

368. I previously analyzed Tew '640 in view of the following limitations:

- "An optical . . . apparatus[,]" discussed above in Section IX.1.a.ii (Paragraphs 186-189).

I incorporate that analysis by reference.

(lxxxi) *'906 Patent, [100-a] "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal"*

369. I previously analyzed Tew '640 in view of the following limitations:

- “an output port and fiber collimators serving as an input port and one or more other ports[,]” discussed above in Section IX.1.a.ii (Paragraphs 186-189); and
- “multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports [,]” discussed above in Section IX.1.a.xlix (Paragraphs 310-313).

I incorporate that analysis by reference.

370. Under Capella’s apparent interpretation, Tew ’640 discloses to a POSITA “an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal.”

371. Tew ’640 discloses a signal from an input fiber being collimated. For example, in “FIG. 10, light from an input fiber 1000 is collimated by an optic 1002 and strikes a beam separator such as diffraction grating 1004.” Tew ’640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23.

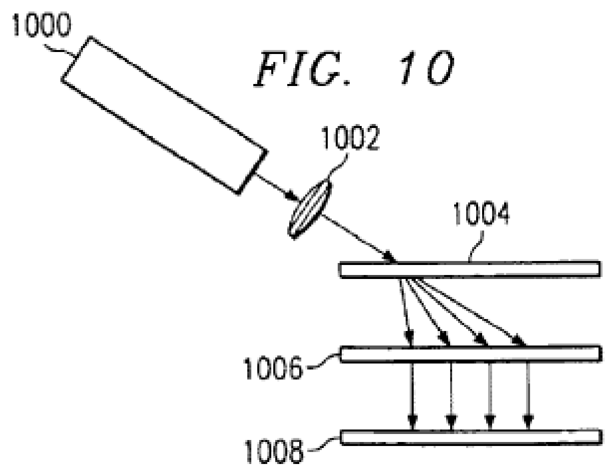


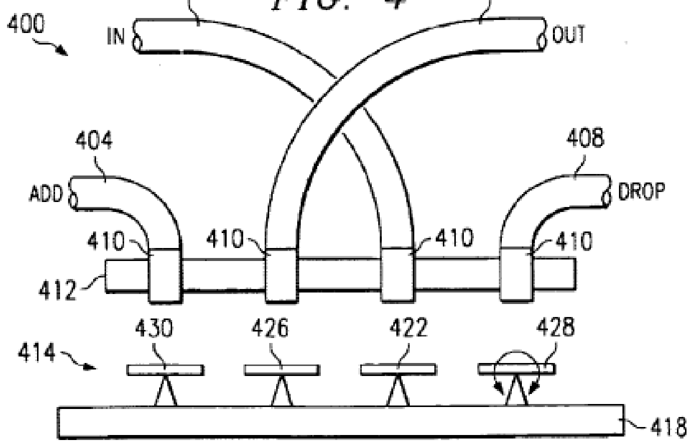
FIG. 10

372. Tew ’640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10. Tew ’640 discloses having a first input fiber providing a signal and a second input fiber (such as the “add” fiber to provide an additional signal), and a first output fiber to receive the signal and a second output fiber (such as the “drop” fiber to drop a signal). For example, in “FIG. 4, the

OADM 400 has two inputs and two outputs. A first input fiber 402 provides an optical signal to the OADM 400. This first input fiber 402, the "in" fiber, typically provides signals from remote portions of an optical network. A second input 404, the "add" fiber, allows a local signal to be transmitted by the network. The two output fibers include a first output 406, typically connected to the rest of the network, and a second output 408, typically used to deliver a signal to local equipment." Tew '640 at 8:14-22; *see also* Provisional Application No. 60/236,532 at 15:12-17.

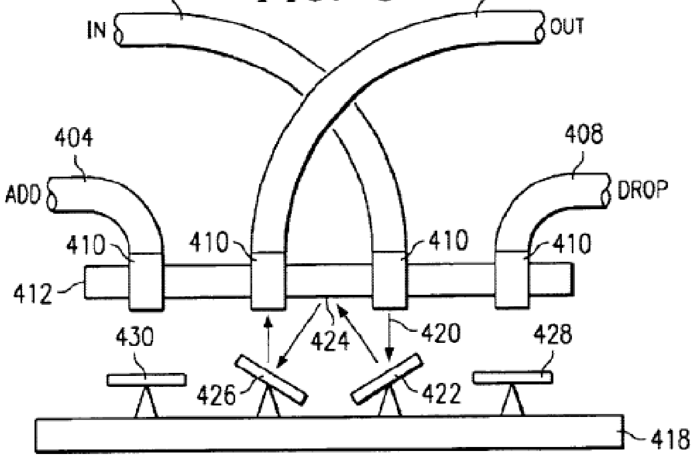
373. Additionally, Figures 4-8 (reprinted below) disclose multiple input ports that can have fiber collimators. Thus, Tew '640 discloses an array of fiber collimators. For example,

FIG. 4



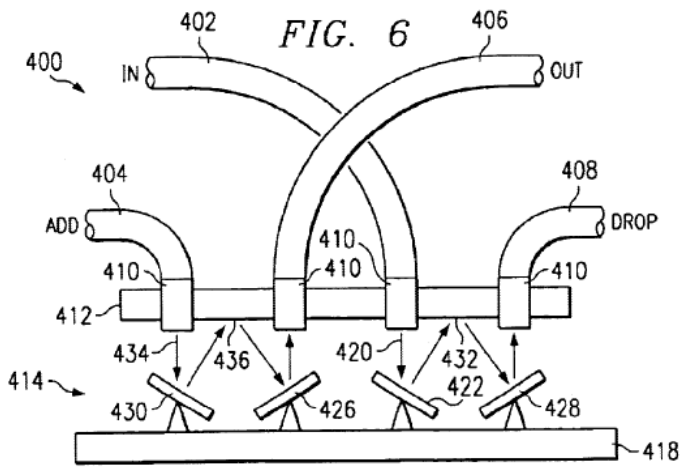
Tew '640 at FIG. 4; *see also* Provisional Application No. 60/236,532 at FIG. 4.

FIG. 5

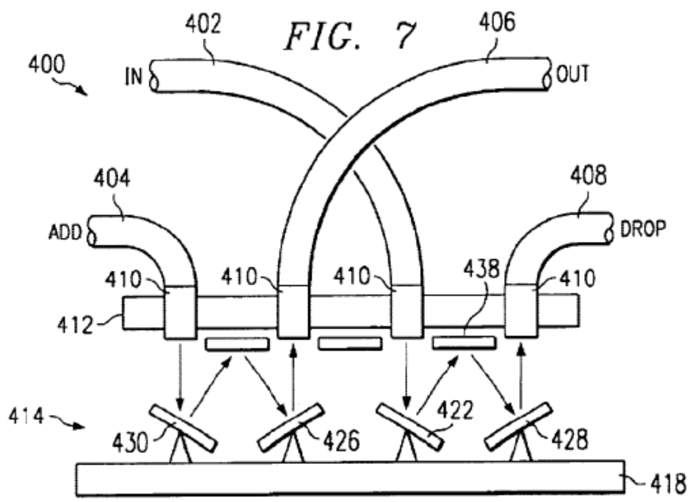


Tew ’640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.

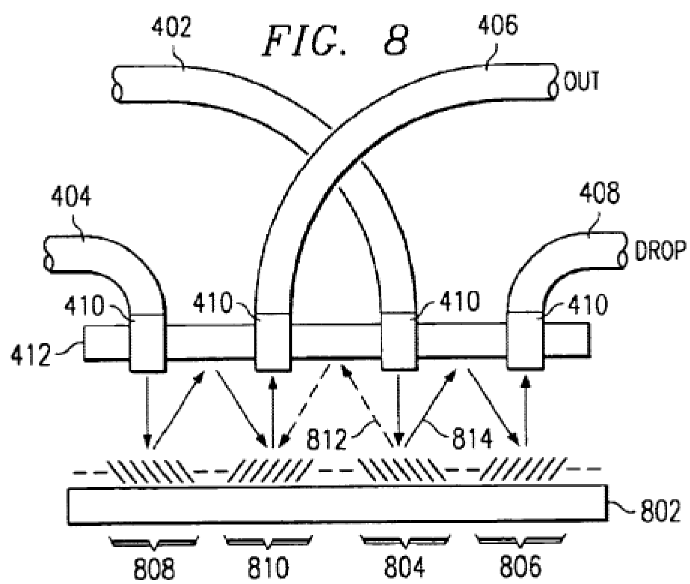
FIG. 6



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.



Tew ’640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

374. Additionally, components such as fiber collimators can be added to different portions of the embodiments, as would suit the optical designer. For example, "focusing optics may be added between the input fibers and the wavelength separators, between the wavelength combiners 914 and the output fibers, and between the mirror array 908 and separators 906 or combiners 914. Furthermore, although shown as separate separators 906 and combiners 914, it

should be understood that other configurations are intended by this disclosure." Tew ’640 at 10:21-34; *see also* Provisional Application No. 60/236,532 at 19:9-17.

375. Therefore, under Capella’s apparent interpretation, Tew ’640 discloses to a POSITA “an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxxii) *’906 Patent, [100-b] “a plurality of output ports”*

376. I previously analyzed Tew ’640 in view of the following limitations:

- “an output port and fiber collimators serving as an input port and one or more other ports[,]” discussed above in Section IX.1.a.iii (Paragraphs 190-192).

I incorporate that analysis by reference.

(lxxxiii) *’906 Patent, [100-c] “a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels”*

377. I previously analyzed Tew ’640 in view of the following limitations:

- “a wavelength-selective device for spatially separating said spectral channels[,]” discussed above in Section IX.1.a.vi (Paragraphs 200-202).

I incorporate that analysis by reference.

(lxxxiv) *’906 Patent, [100-d] “a beam-focuser, for focusing said spectral channels into corresponding spectral spots”*

378. I previously analyzed Tew ’640 in view of the following limitations:

- “a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]” discussed above in Section IX.1.a.xvi (Paragraphs 240-243).
- “a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]” discussed above in Section IX.1.a.li (Paragraphs 315-319).

I incorporate that analysis by reference.

(lxxxv) *'906 Patent, [100-e] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually and continuously controllable to reflect said spectral channels into selected ones of said output ports"*

379. I previously analyzed Tew '640 in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.a.lii (Paragraphs 320-323).

I incorporate that analysis by reference.

(lxxxvi) *'906 Patent, [100-f] "a one-dimensional array of collimator-alignment mirrors, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports"*

380. I previously analyzed Tew '640 in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.a.xiii (Paragraphs 229-232);

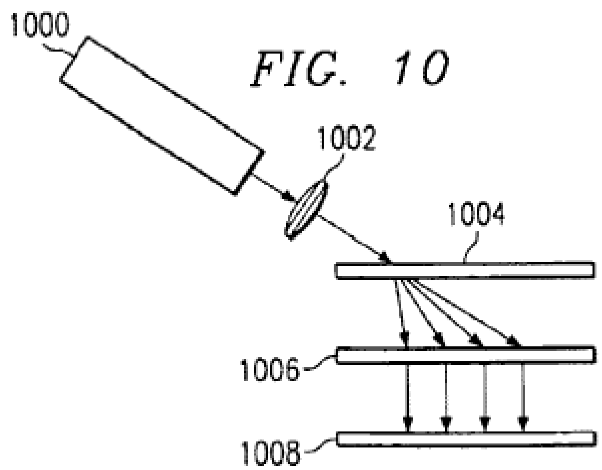
- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.a.xlvii (Paragraphs 304-306); and

- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.a.lvi (Paragraphs 329-331)

I incorporate that analysis by reference.

381. Tew '640 discloses to a POSITA "a one-dimensional array of collimator-alignment mirrors, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports."

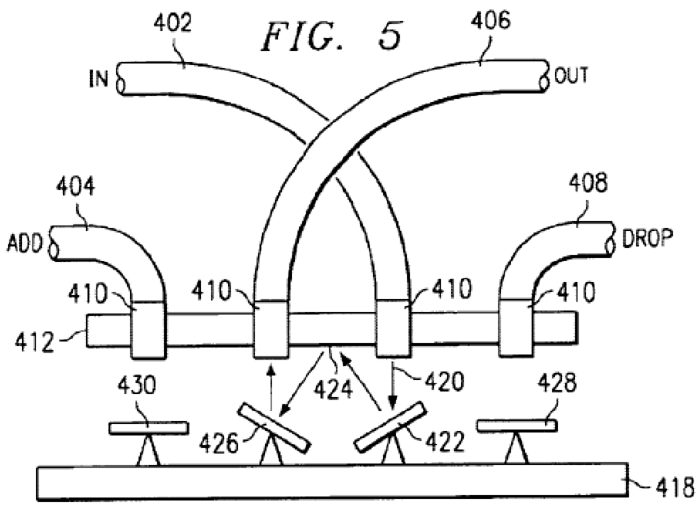
382. Additionally, Tew '640 discloses a signal from an input fiber being collimated. For example, in "FIG. 10, light from an input fiber 1000 is collimated by an optic 1002 and strikes a beam separator such as diffraction grating 1004." Tew '640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23.



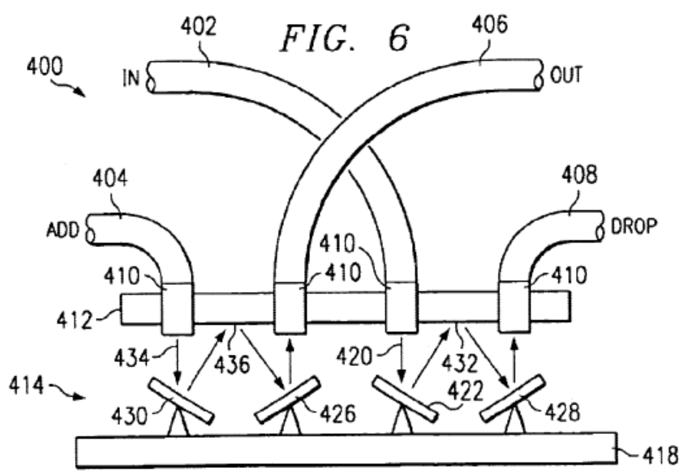
Tew '640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10. Additionally, Tew '640 discloses having a first input fiber providing a signal and a second input fiber (such as the "add" fiber to provide an additional signal), and a first output fiber to receive the signal and a second output fiber (such as the "drop" fiber to drop a signal). For example, in "FIG. 4, the OADM 400 has two inputs and two outputs. A first input fiber 402 provides an optical signal to

the OADM 400. This first input fiber 402, the "in" fiber, typically provides signals from remote portions of an optical network. A second input 404, the "add" fiber, allows a local signal to be transmitted by the network. The two output fibers include a first output 406, typically connected to the rest of the network, and a second output 408, typically used to deliver a signal to local equipment." Tew ’640 at 8:14-22; *see also* Provisional Application No. 60/236,532 at 15:12-17.

383. Tew ’640 discloses micromirrors placed to either receive an input signal from an input fiber or an add fiber, or transmit an output signal to an output fiber or a drop fiber. For example, "[t]he micromirror array 414 of FIG. 4 includes four discrete mirrors 416. Each of the mirrors 422, 426, 428, 430 is operable to tilt clockwise or counterclockwise about an axis perpendicular to the plane of FIG. 4." Tew ’640 at 8:32-40; *see also* Provisional Application No. 60/236,532 at 16:1-6. As another example, "[i]n FIG. 6, the first mirror 422 is rotated clockwise to a second position. In the second position, the first mirror 422 reflects light beam 420 from the first input fiber 402 to a second point or region 432 on the holding block 412. From the second region 432, the light beam 420 travels to a second mirror 428 and is reflected to the second output fiber 408, the "drop" fiber." Tew ’640 at 8:56-64; *see also* Provisional Application No. 60/236,532 at 16:17-22. Figures 5-7, replicated below, show the mirrors (reference numbers 422, 424, 428, and 430) either receiving or transmitting the signals.

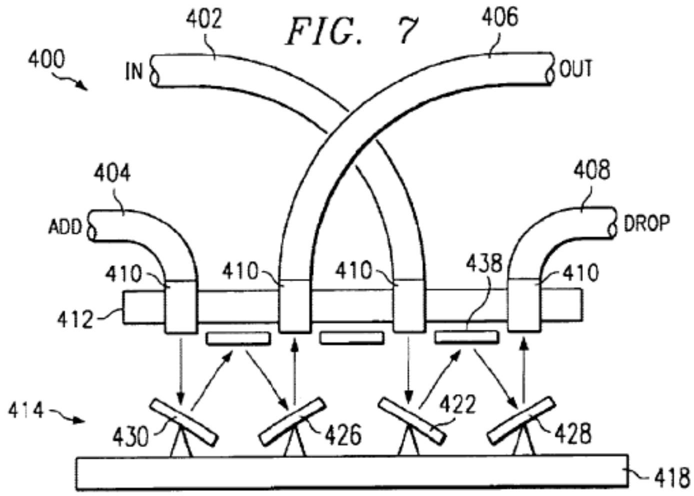


Tew ’640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.

FIG. 7



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7. Thus, the mirrors can be used to align the signal with the collimators from the input fibers and/or the output fibers.

384. Therefore, Tew ’640 discloses to a POSITA "a one-dimensional array of collimator-alignment mirrors, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports." Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Tew ’640 does not teach "pivotal about two axes[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxxvii) *’906 Patent, [106] “The optical apparatus of claim 100, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator”*

385. I previously analyzed Tew ’640 in view of the following limitations:

- “wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]”discussed above in Section IX.1.a.xix (Paragraphs 255-256).

I incorporate that analysis by reference.

(lxxxviii) *'906 Patent, [115-pre] "An optical system comprising a wavelength-separating-routing apparatus, wherein said wavelength-separating-routing apparatus includes"*

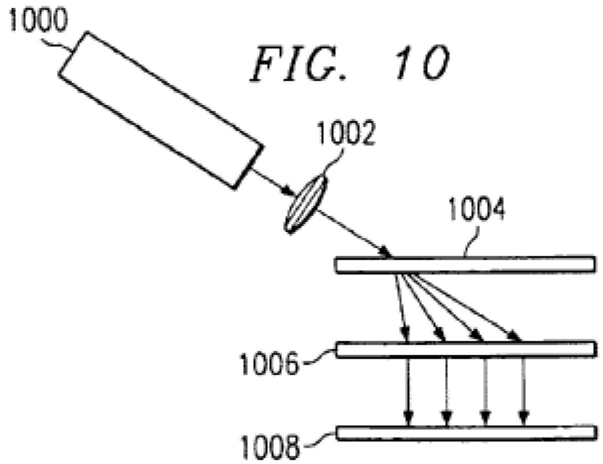
386. I previously analyzed Tew '640 in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]" discussed above in Section IX.1.a.xlviii (Paragraphs 307-309).

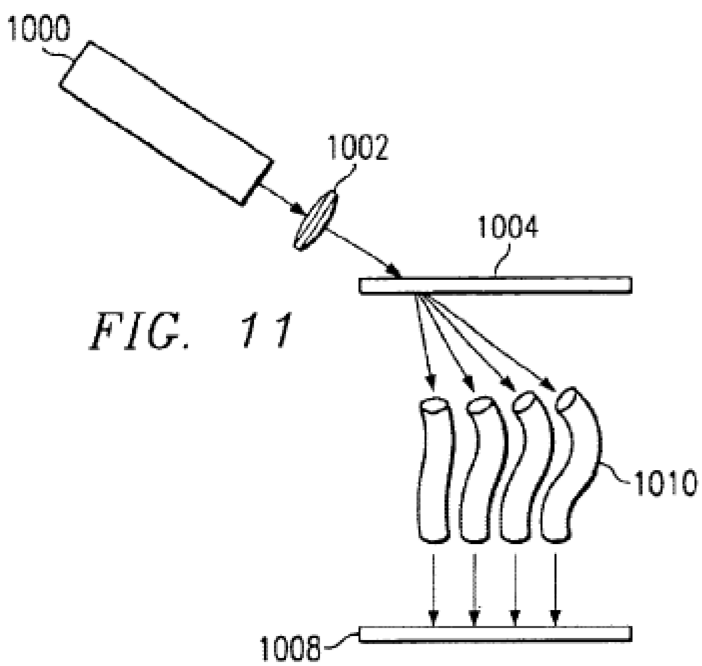
I incorporate that analysis by reference.

387. To the extent the language in the preamble is considered limiting, Tew '640 discloses to a POSITA "an optical system comprising a wavelength-separating-routing apparatus."

388. Tew '640 discloses "[a]n optical switch ideally suited for use as an optical add drop multiplexer (OADM)" that uses reflectors and deflectors to receive and transmit light. Tew '640 at Abstract; *see also* Provisional Application No. 60/236,532 at Abstract. For example, "[a] light beam entering the OADM through a first input fiber (402) is separated by wavelength to yield multiple light beams (902, 904)." Tew '640 at Abstract; *see also* Provisional Application No. 60/236,532 at Abstract. Further, Figure 10, reprinted below, "light from an input fiber 1000 is collimated by an optic 1002 and strikes a <u>beam separator such as diffraction grating 1004. The diffraction grating spatially separates the component beams of the input light beam</u>" (emphasis added). Tew '640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23.



Tew '640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10. Additionally, in Figure 11, reprinted below, the light separated from by the beam separator (diffraction grating 1004) can be individually captured by a number of fibers. For example, "[t]he separated beams are then individually captured by a set of optical fibers 1010. The optical fibers 1010 re-emit the separated light beams to the mirror array 1008." Tew '640 at 10:44-50; *see also* Provisional Application No. 60/236,532 at 20:1-5.



Tew '640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11.

389. Therefore, Tew ’640 discloses to a POSITA “an optical system comprising a wavelength-separating-routing apparatus.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxxix) *’906 Patent, [115-a] “an array of fiber collimators, providing and serving as an input port for a multi-wavelength optical signal”*

390. I previously analyzed Tew ’640 in view of the following limitations:

- “an output port and fiber collimators serving as an input port and one or more other ports[,]” discussed above in Section IX.1.a.ii (Paragraphs 186-189);
- “multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]” discussed above in Section IX.1.a.xlix (Paragraphs 310-313); and
- “an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal[,]” discussed above in Section IX.1.a.lxxxi (Paragraphs 369-375).

I incorporate that analysis by reference.

(xc) *’906 Patent, [115-b] “a plurality of output ports including a pass-through port and one or more drop ports”*

391. I previously analyzed Tew ’640 in view of the following limitations:

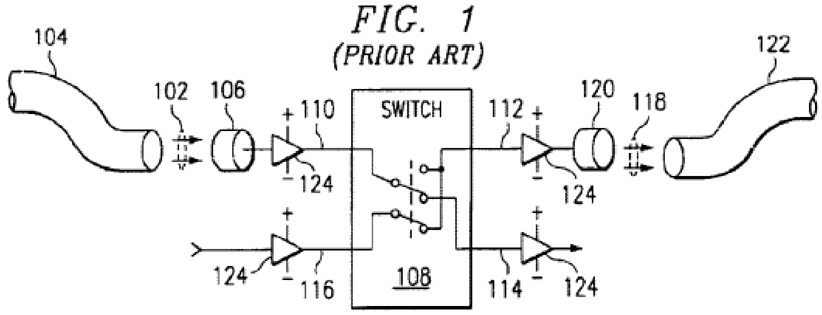
- “an output port and fiber collimators serving as an input port and one or more other ports[,]” discussed above in Section IX.1.a.iii (Paragraphs 190-192); and
- “wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]” discussed above in Section IX.1.a.xv (Paragraphs 236-239).

I incorporate that analysis by reference.

392. Tew ’640 discloses to a POSITA “pass-through port.”

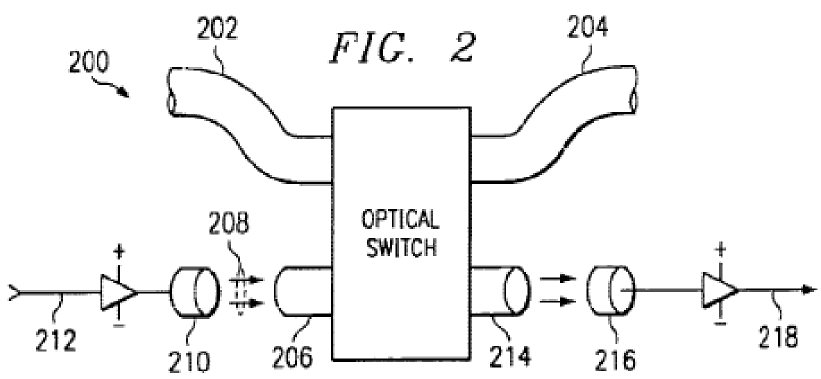
393. Tew '640 discloses a pass-through port that can be used to re-transmit a signal. As shown in Figure 1 (reprinted below), "[w]hen the switch is in a first position, the signal on the first input 110 is passed through to the first output 112 and retransmitted." Tew '640 at 4:30-42; *see also* Provisional Application No. 60/236,532 at 8:12-19.

FIG. 1
(PRIOR ART)



Tew '640 at FIG. 1; *see also* Provisional Application No. 60/236,532 at FIG. 1. As further described and shown in Figure 2 (reprinted below), "[s]ignals that have yet to reach their intended destination are passed through the first output 204 and continue along the fiber to another node of the network." Tew '640 at 4:66-5:18; *see also* Provisional Application No. 60/236,532 at 9:12-10:2.

FIG. 2



Tew '640 at FIG. 2; *see also* Provisional Application No. 60/236,532 at FIG. 2.

394. Therefore, Tew '640 discloses to a POSITA "pass-through port." Even if Tew '640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xci) *’906 Patent, [115-c] “a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels”*

395. I previously analyzed Tew ’640 in view of the following limitations:

- “a wavelength-selective device for spatially separating said spectral channels[,]” discussed above in Section IX.1.a.vi (Paragraphs 200-202).

I incorporate that analysis by reference.

(xcii) *’906 Patent, [115-d] “a beam-focuser, for focusing said spectral channels into corresponding spectral spots”*

396. I previously analyzed Tew ’640 in view of the following limitations:

- “a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]” discussed above in Section IX.1.a.xvi (Paragraphs 240-243).

- “a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]” discussed above in Section IX.1.a.li (Paragraphs 315-319).

I incorporate that analysis by reference.

(xciii) *’906 Patent, [115-e] “a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels.”*

397. I previously analyzed Tew ’640 in view of the following limitations:

- “a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]” discussed above in Section IX.1.a.vii (Paragraphs 203-214); and

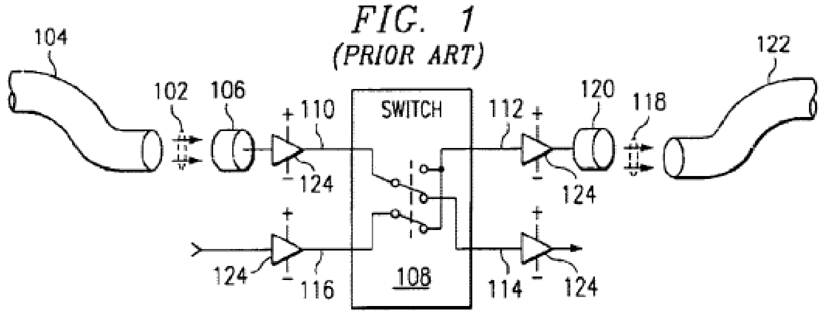
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.a.lii (Paragraphs 320-323)

I incorporate that analysis by reference.

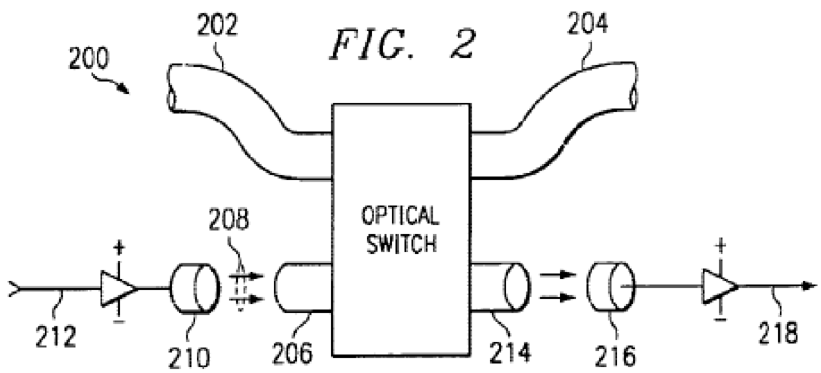
398. Tew '640 discloses to a POSITA "said fiber collimator pass-through port receives a subset of said spectral channels."

399. Tew '640 discloses a pass-through port that can be used to re-transmit a signal. A POSITA would know that to re-transmit a signal is to pass the signal through an input port again. As shown in Figure 1 (reprinted below), "[w]hen the switch is in a first position, the signal on the first input 110 is passed through to the first output 112 and retransmitted." Tew '640 at 4:30-42; *see also* Provisional Application No. 60/236,532 at 8:12-19.

FIG. 1
(PRIOR ART)



Tew '640 at FIG. 1; *see also* Provisional Application No. 60/236,532 at FIG. 1. As further described and shown in Figure 2 (reprinted below), "[s]ignals that have yet to reach their intended destination are passed through the first output 204 and continue along the fiber to another node of the network." Tew '640 at 4:66-5:18; *see also* Provisional Application No. 60/236,532 at 9:12-10:2.



Tew '640 at FIG. 2; *see also* Provisional Application No. 60/236,532 at FIG. 2.

400. Therefore, Tew '640 discloses to a POSITA "said fiber collimator pass-through port receives a subset of said spectral channels." Even if Tew '640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(xciv)** *'906 Patent, [116] "The optical system of claim 115 further comprising a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports"*

401. I previously analyzed Tew '640 in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.a.ix (Paragraphs 218-221);

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.a.x (Paragraph 222);

- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.a.xxii (Paragraph 262); and

- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined

coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.a.liii (Paragraphs 324-325).

I incorporate that analysis by reference.

(xcv) *'906 Patent, [117] "The optical system of claim 116 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

402. I previously analyzed Tew '640 in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.a.ix (Paragraphs 218-221); and

- "said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors[,]" discussed above in Section IX.1.a.liv (Paragraphs 326-327).

I incorporate that analysis by reference.

(xcvi) *'906 Patent, [118] "The optical system of claim 115 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimators, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports."*

403. I previously analyzed Tew '640 in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.a.xiii (Paragraphs 229-232);

- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.a.xlvii (Paragraphs 304-306); and

- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.a.lvi (Paragraphs 329-331)

I incorporate that analysis by reference.

(xcvii) *'906 Patent, [122] "The optical system of claim 115 wherein each channel micromirror is a silicon micromachined mirror."*

404. I previously analyzed Tew '640 in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.a.lvii (Paragraphs 332-334).

I incorporate that analysis by reference.

(xcviii) *'906 Patent, [123] "The optical system of claim 115 wherein said beam-focuser comprises a focusing lens having first and second focal points, and wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points"*

405. I previously analyzed Tew '640 in view of the following limitations:

- "wherein said beam-focuser comprises a focusing lens having first and second focal points[,]"discussed above in Section IX.1.a.lix (Paragraphs 336-339); and
- "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens[,]"discussed above in Section IX.1.a.lx (Paragraphs 340-342).

I incorporate that analysis by reference.

(xcix) *'906 Patent, [124] "The optical system of claim 115 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

406. I previously analyzed Tew '640 in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.a.xvii (Paragraphs 244-250).

I incorporate that analysis by reference.

(c) *'906 Patent, [125] "The optical system of claim 115 further comprising a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors"*

407. I previously analyzed Tew '640 in view of the following limitations:

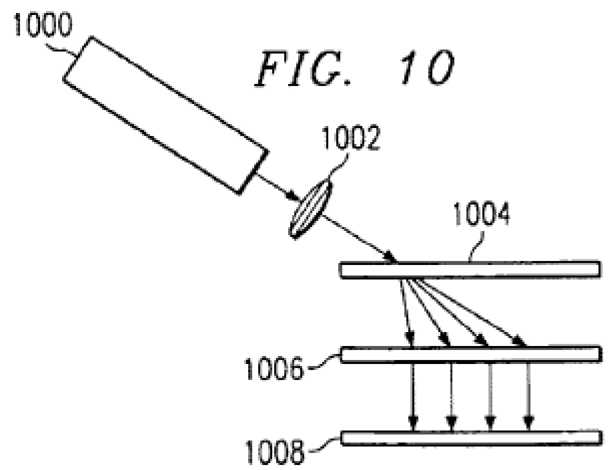
- "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors[,]"discussed above in Section IX.1.a.lxiii (Paragraph 348).

I incorporate that analysis by reference.

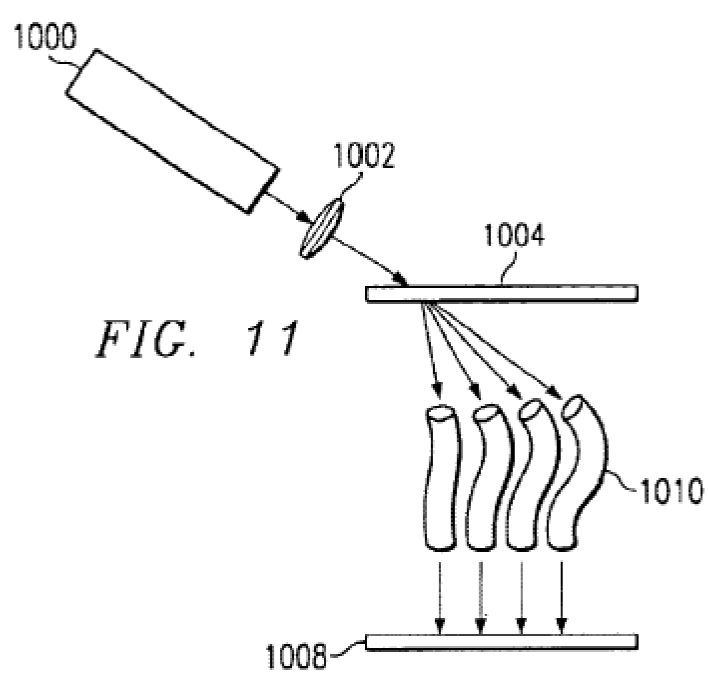
(ci) *'906 Patent, [126-pre] "The optical system of claim 115 further comprising an auxiliary wavelength-separating-routing apparatus, including:"*

408. To the extent the language in the preamble is considered limiting, Tew '640 discloses to a POSITA "The optical system of claim 115 further comprising an auxiliary wavelength-separating-routing apparatus."

409. Tew '640 discloses a wavelength-separating-routing apparatus. For example, "[a] light beam entering the OADM through a first input fiber (402) is separated by wavelength to yield multiple light beams (902, 904)." Tew '640 at Abstract; *see also* Provisional Application No. 60/236,532 at Abstract. Further, Figure 10, reprinted below, shows "light from an input fiber 1000 is collimated by an optic 1002 and strikes a <u>beam separator such as diffraction grating 1004. The diffraction grating spatially separates the component beams of the input light beam</u>" (emphasis added). Tew '640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23.

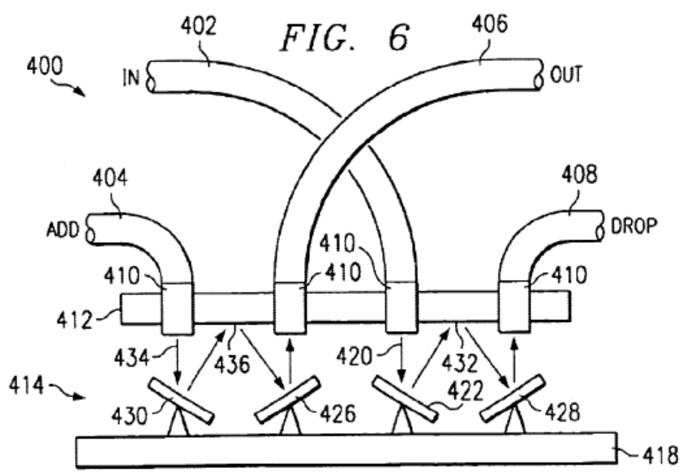


Tew '640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10. Additionally, in Figure 11, reprinted below, the light separated from by the beam separator (diffraction grating 1004) can be individually captured by a number of fibers. For example, "[t]he separated beams are then individually captured by a set of optical fibers 1010. The optical fibers 1010 re-emit the separated light beams to the mirror array 1008." Tew '640 at 10:44-50; *see also* Provisional Application No. 60/236,532 at 20:1-5.

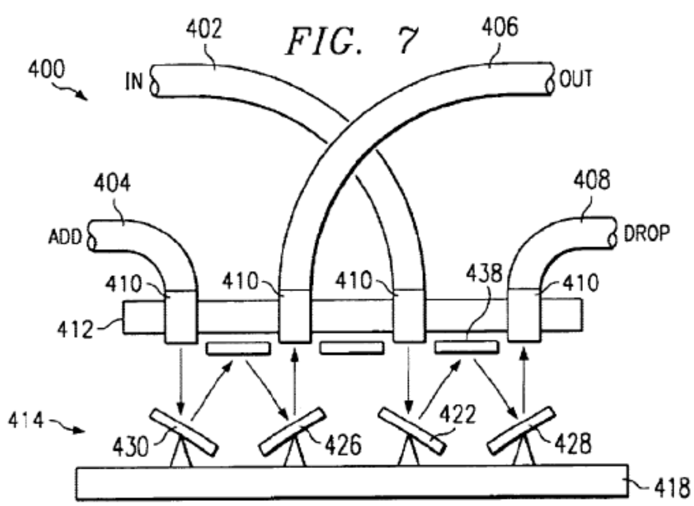


Tew '640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11.

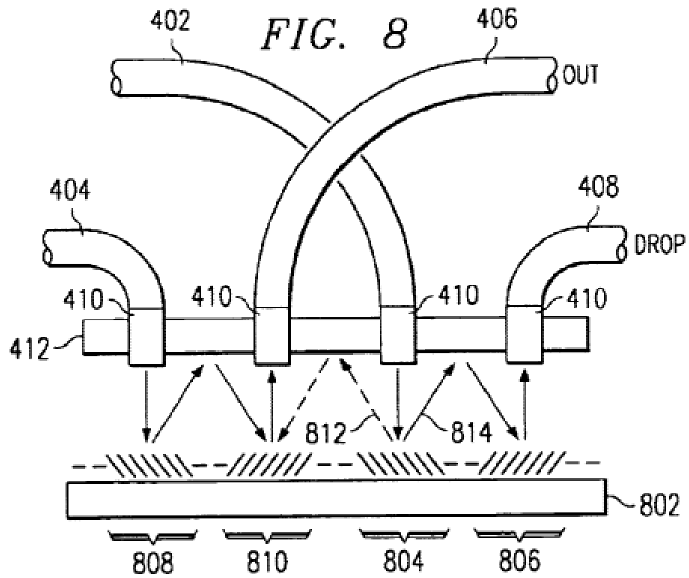
410. Additionally, there can be multiple input fibers. As shown in Figures 6-8 (reproduced below) can provide a second auxiliary input (e.g., the add fiber 404) to the first input (e.g., the input fiber 402). For example, "At the same time the light beam 420 from the "in" fiber 402 is being dropped, another light beam 434 is provided to the first output fiber 406. The second light beam 434 exits the second input fiber 404, the "add" fiber."" Tew '640 at 8:65-9:1; *see also* Provisional Application No. 60/236,532 at 17:1-3. Therefore, there can be multiple input fibers where at least one fiber (e.g., the add fiber) can serve as an auxiliary wavelength-separating-routing apparatus.



Tew '640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.



Tew ’640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

411. Therefore, Tew ’640 discloses to a POSITA “The optical system of claim 115 further comprising an auxiliary wavelength-separating-routing apparatus” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

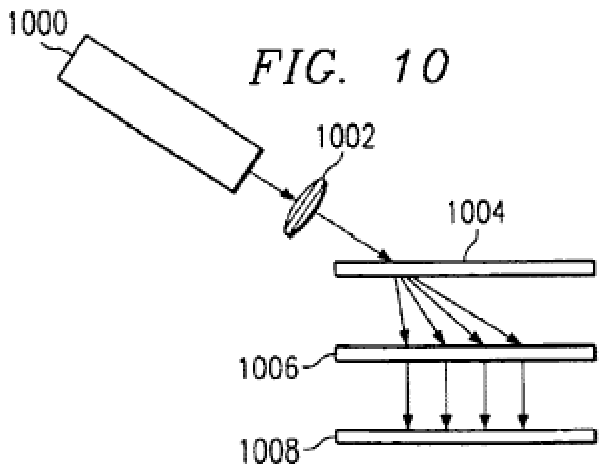
(cii) *’906 Patent, [126-a] “multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports”*

412. Under Capella’s apparent interpretation, Tew ’640 discloses to a POSITA “multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports.”

413. Tew ’640 discloses to a POSITA “The optical system of claim 115 further comprising an auxiliary wavelength-separating-routing apparatus.”

414. Tew ’640 discloses a wavelength-separating-routing apparatus. For example, “[a] light beam entering the OADM through a first input fiber (402) is separated by wavelength to

yield multiple light beams (902, 904)." Tew '640 at Abstract; *see also* Provisional Application No. 60/236,532 at Abstract. Further, Figure 10, reprinted below, shows "light from an input fiber 1000 is collimated by an optic 1002 and strikes a beam separator such as diffraction grating 1004. The diffraction grating spatially separates the component beams of the input light beam" (emphasis added). Tew '640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23.



Tew '640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10. Additionally, in Figure 11, reprinted below, the light separated from by the beam separator (diffraction grating 1004) can be individually captured by a number of fibers. For example, "[t]he separated beams are then individually captured by a set of optical fibers 1010. The optical fibers 1010 re-emit the separated light beams to the mirror array 1008." Tew '640 at 10:44-50; *see also* Provisional Application No. 60/236,532 at 20:1-5.

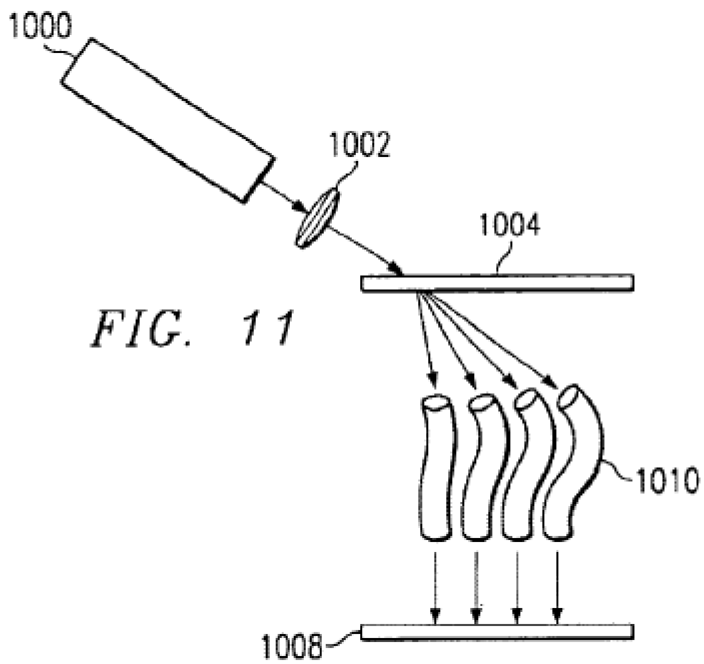
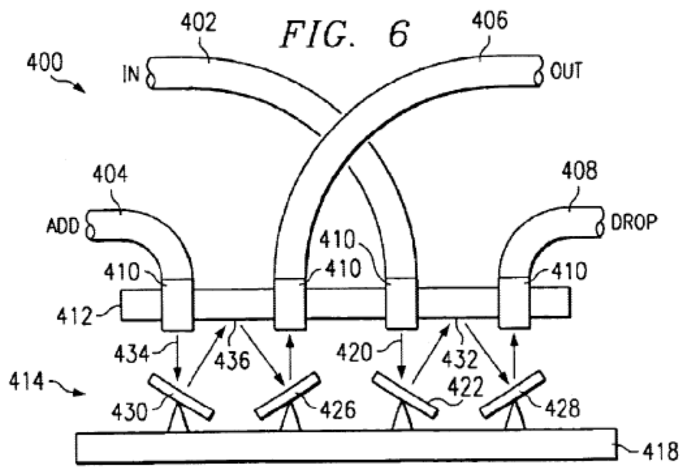


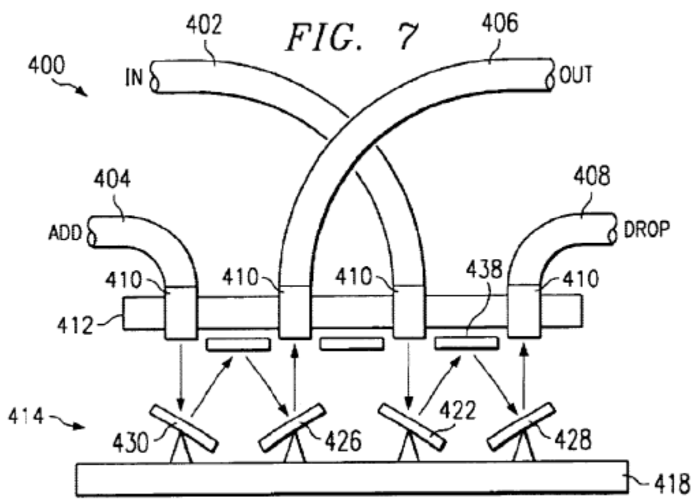
FIG. 11

Tew ’640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11.

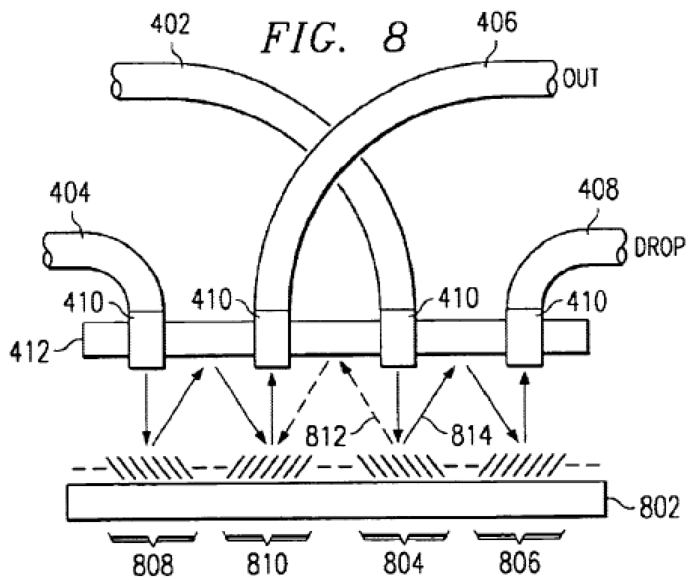
415. Additionally, there can be multiple input fibers. As shown in Figures 6-8 (reproduced below) can provide a second auxiliary input (e.g., the add fiber 404) to the first input (e.g., the input fiber 402). For example, “At the same time the light beam 420 from the "in" fiber 402 is being dropped, another light beam 434 is provided to the first output fiber 406. The second light beam 434 exits the second input fiber 404, the "add" fiber.”” Tew ’640 at 8:65-9:1; *see also* Provisional Application No. 60/236,532 at 17:1-3.



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.



Tew ’640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8. To the extent that “fiber collimator” port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a “fiber collimator” port in a single package.

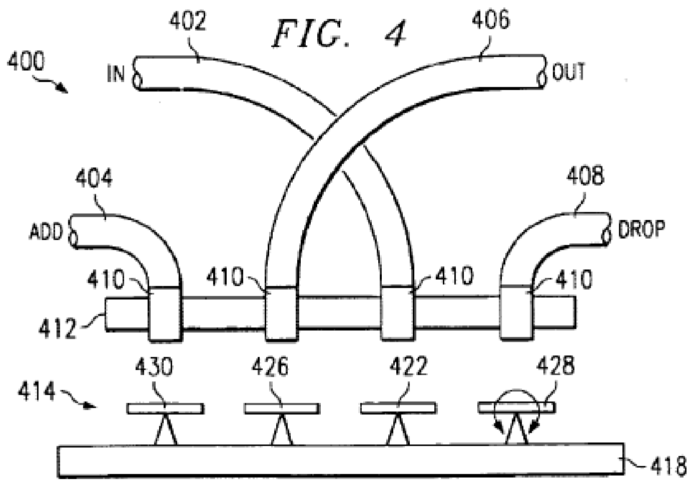
416. Therefore, under Capella’s apparent interpretation, Tew ’640 discloses to a POSITA “multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(ciii) *’906 Patent, [126-b] “an exiting port”*

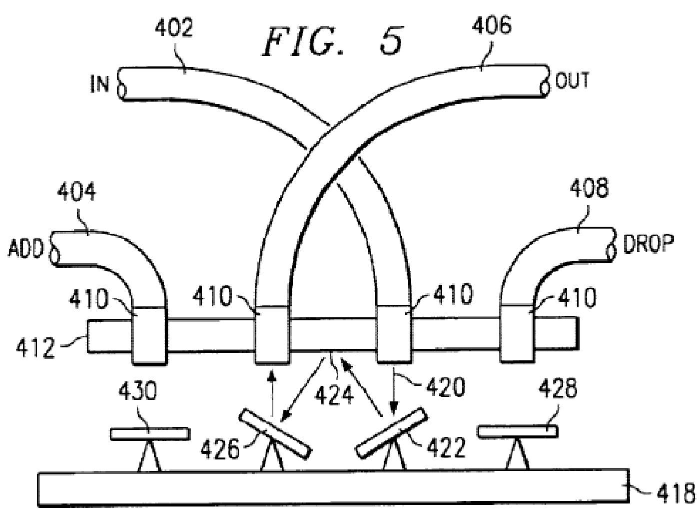
417. Tew ’640 discloses to a POSITA “an exiting port.”

418. Tew ’640 discloses the multiple output ports. As shown in Figures 4-8 (reprinted below), there are two fibers that can serve as output ports: the first output fiber 406 (the output fiber) and the second output fiber 408 (the drop fiber). For example, “the first mirror 422 reflects light beam 420 from the first input fiber 402 to … the second output fiber 408, the

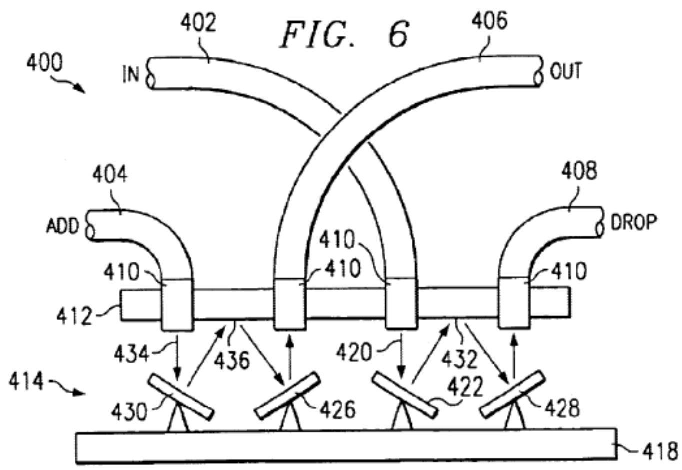
"drop" fiber.” Tew ’640 at 8:56-64; *see also* Provisional Application No. 60/236,532 at 16:17-22. As another example, “[t]he second light beam 434 exits the second input fiber 404, the "add" fiber, and is reflected by a third mirror 430 to … the first output fiber 406.” Tew ’640 at 8:67-9:6; *see also* Provisional Application No. 60/236,532 at 17:2-6.



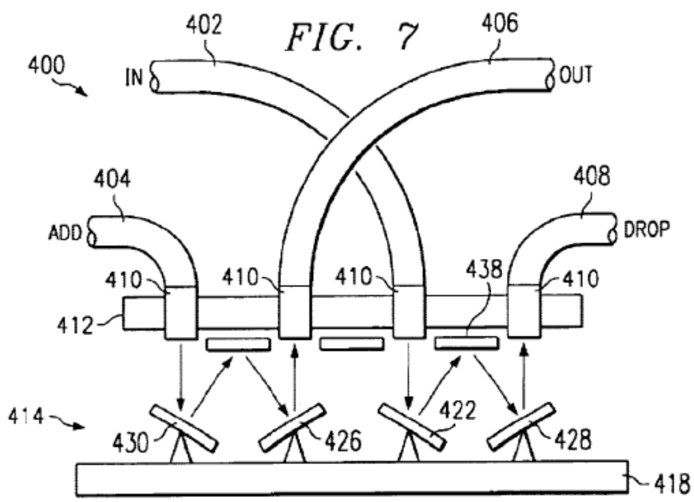
Tew ’640 at FIG. 4; *see also* Provisional Application No. 60/236,532 at FIG. 4.



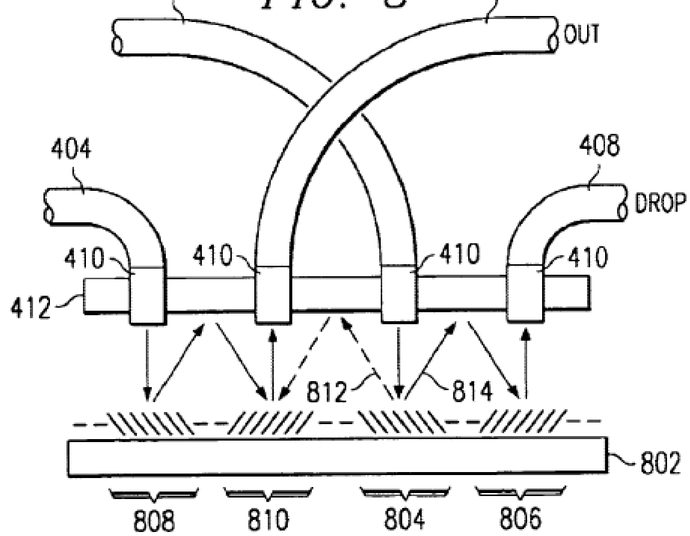
Tew ’640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.



Tew '640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew '640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.



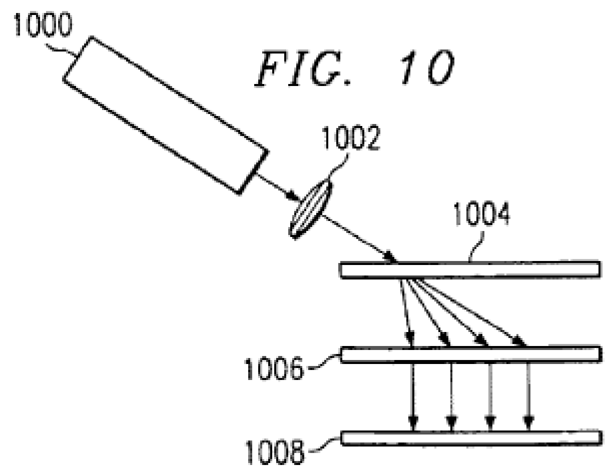
Tew ’640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

419. Therefore, Tew ’640 discloses to a POSITA “an exiting port.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

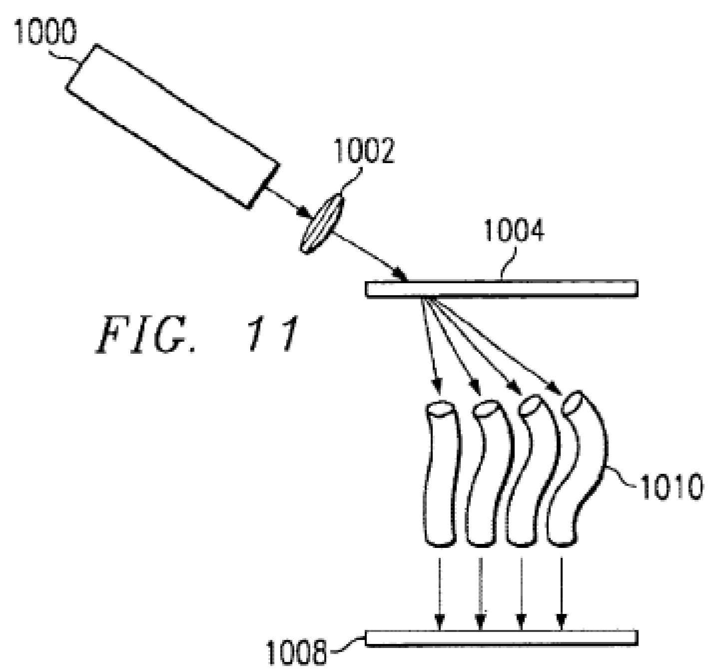
(civ) *‘’906 Patent, [126-c] “an auxiliary wavelength-separator”*

420. Tew ’640 discloses to a POSITA “an auxiliary wavelength-separator.”

421. Tew ’640 discloses an auxiliary wavelength-separator. For example, “[a] light beam entering the OADM through a first input fiber (402) is separated by wavelength to yield multiple light beams (902, 904).” Tew ’640 at Abstract; *see also* Provisional Application No. 60/236,532 at Abstract. Further, Figure 10, reprinted below, shows “light from an input fiber 1000 is collimated by an optic 1002 and strikes a <u>beam separator such as diffraction grating 1004. The diffraction grating spatially separates the component beams of the input light beam</u>” (emphasis added). Tew ’640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23.

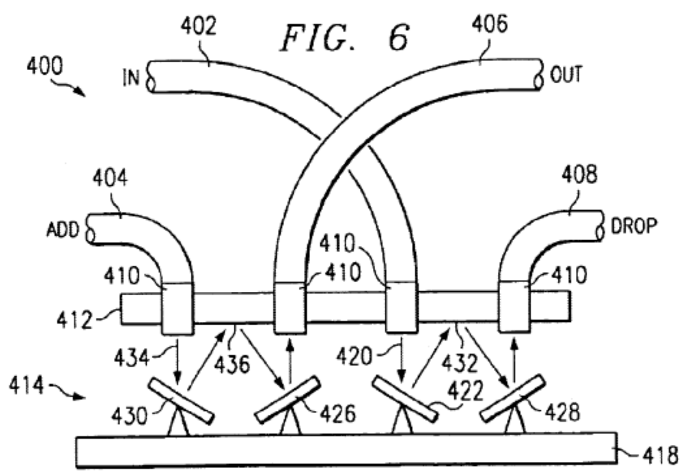


Tew ’640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10. Additionally, in Figure 11, reprinted below, the light separated from by the beam separator (diffraction grating 1004) can be individually captured by a number of fibers. For example, “[t]he separated beams are then individually captured by a set of optical fibers 1010. The optical fibers 1010 re-emit the separated light beams to the mirror array 1008.” Tew ’640 at 10:44-50; *see also* Provisional Application No. 60/236,532 at 20:1-5.

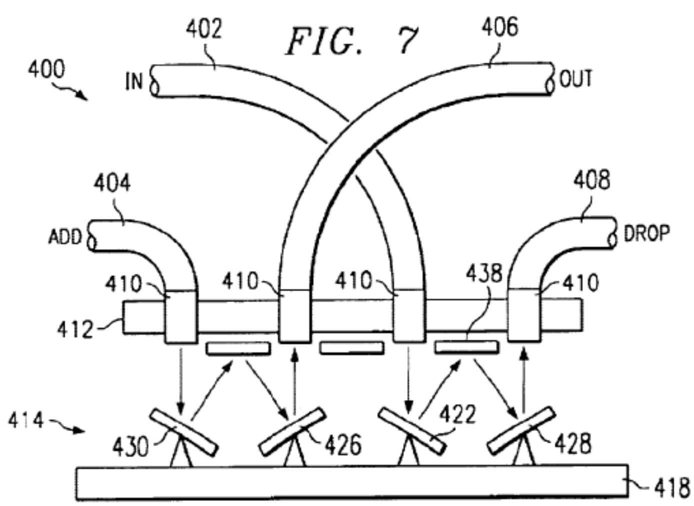


Tew ’640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11.

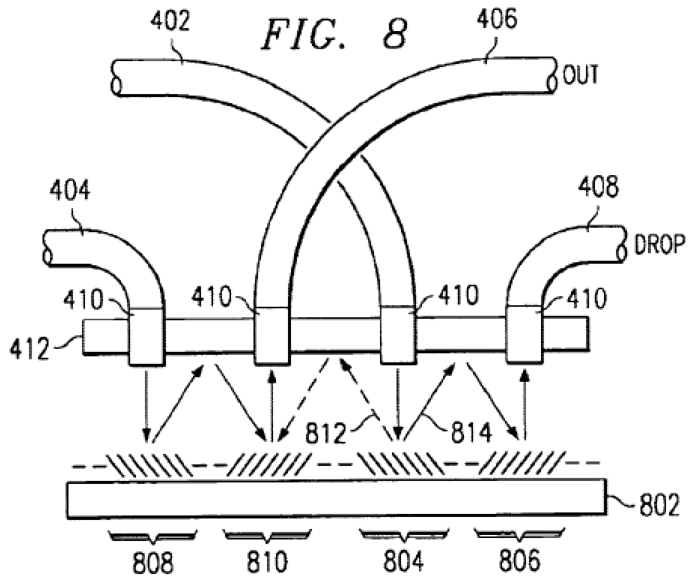
422. Additionally, there can be multiple input fibers. As shown in Figures 6-8 (reproduced below) can provide an auxiliary input (e.g., the add fiber 404) to the first input (e.g., the input fiber 402). For example, "at the same time the light beam 420 from the "in" fiber 402 is being dropped, another light beam 434 is provided to the first output fiber 406. The second light beam 434 exits the second input fiber 404, the "add" fiber."" Tew '640 at 8:65-9:1; *see also* Provisional Application No. 60/236,532 at 17:1-3. Therefore, there can be multiple input fibers where at least one fiber (e.g., the add fiber) can serve as an auxiliary wavelength-separator.



Tew '640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew '640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.



Tew '640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

423. Therefore, because there can be multiple inputs, each having its own wavelength-separator, Tew '640 discloses to a POSITA "an auxiliary wavelength-separator." Even if Tew '640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cv) *'906 Patent, [126-d] "an auxiliary beam-focuser"*

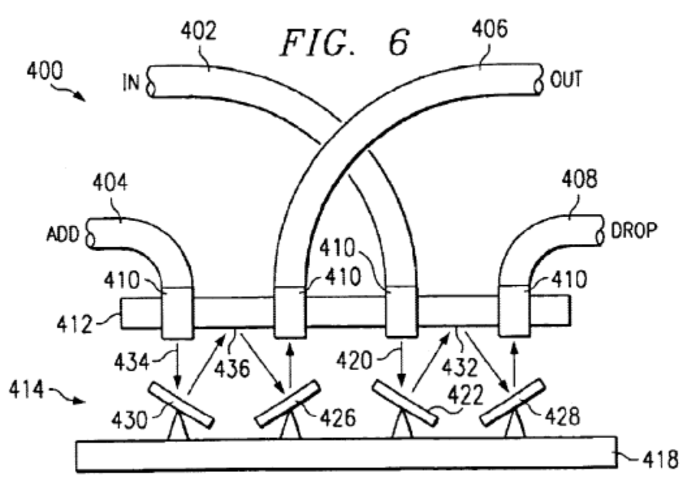
424. Tew '640 discloses to a POSITA "an auxiliary beam-focuser."

425. Tew '640 discloses a beam-focuser. Each fiber can be coupled to a focusing optic, such as "a gradient index lens, designed to control dispersion of the light exiting the fiber." Tew '640 at 8:23-25; *see also* Provisional Application No. 60/236,532 at 15:18-19. "[F]ocusing optics may be added between the input fibers and the wavelength separators, between the wavelength combiners 914 and the output fibers, and between the mirror array 908 and separators 906 or combiners 914." Tew '640 at 10:21-34; *see also* Provisional Application No. 60/236,532 at 19:9-17. As shown in Figures 10 and 11 below, and as discussed prior, once the

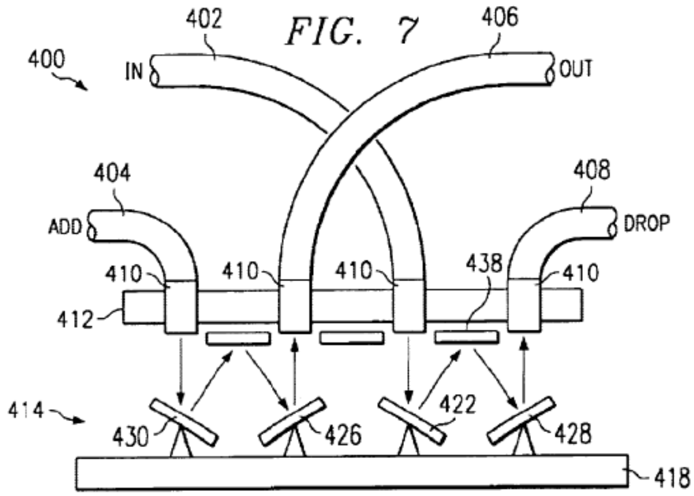
beams are separated, "[t]he component beams are directed by a second focusing optic 1006 to the mirror array 1008. As discussed above, the mirror array selectively directs the beams to one of at least two output fibers." Tew '640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23. "In FIG. 11, light from the input fiber 1000 again is focused onto a beam separator such as diffraction grating 1004 by a focusing optic 1002." Tew '640 at 10:44-56; *see also* Provisional Application No. 60/236,532 at 20:1-9.

426. Additionally, there can be multiple input fibers, each with its own-beam focuser. As shown in Figures 6-8 (reproduced below) can provide a second auxiliary input (e.g., the add fiber 404) to the first input (e.g., the input fiber 402). For example, "At the same time the light beam 420 from the "in" fiber 402 is being dropped, another light beam 434 is provided to the first output fiber 406. The second light beam 434 exits the second input fiber 404, the "add" fiber."" Tew '640 at 8:65-9:1; *see also* Provisional Application No. 60/236,532 at 17:1-3. Therefore, there can be multiple input fibers where at least one fiber (e.g., the add fiber) can serve as an auxiliary beam-focuser.

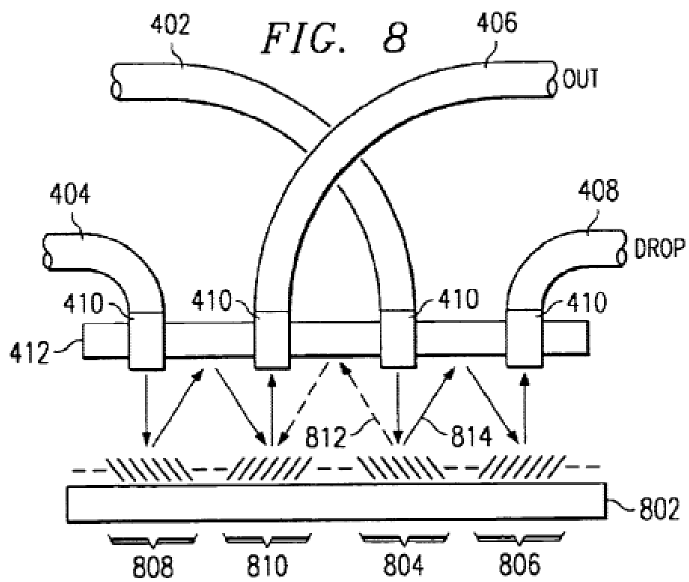
FIG. 6



Tew '640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.



Tew ’640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

427. Therefore, because there can be multiple inputs, each having its own beam-focuser, Tew ’640 discloses to a POSITA “an auxiliary beam-focuser.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cvi) *'906 Patent, [126-e] "a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors"*

428. I previously analyzed Tew '640 in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214);

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.a.lii (Paragraphs 320-323); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels[,]" discussed in Section IX.1.a.xciii (Paragraph 405).

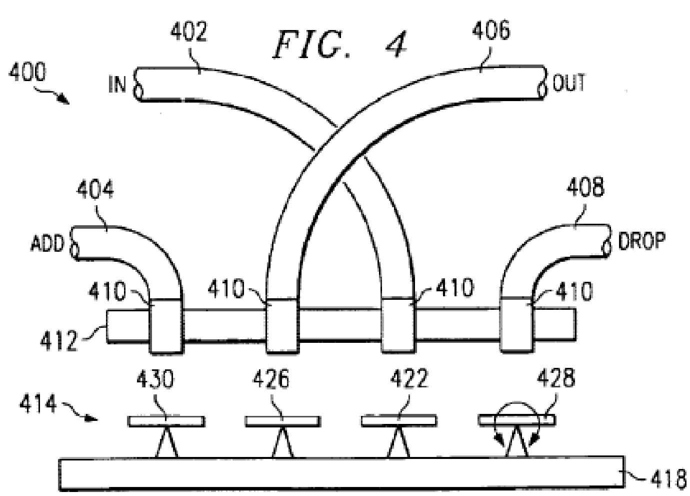
I incorporate that analysis by reference.

(cvii) *'906 Patent, [127] "The optical system of claim 126 wherein said auxiliary channel micromirrors are individually pivotable."*

429. Tew '640 discloses to a POSITA "wherein said auxiliary channel micromirrors are individually pivotable."

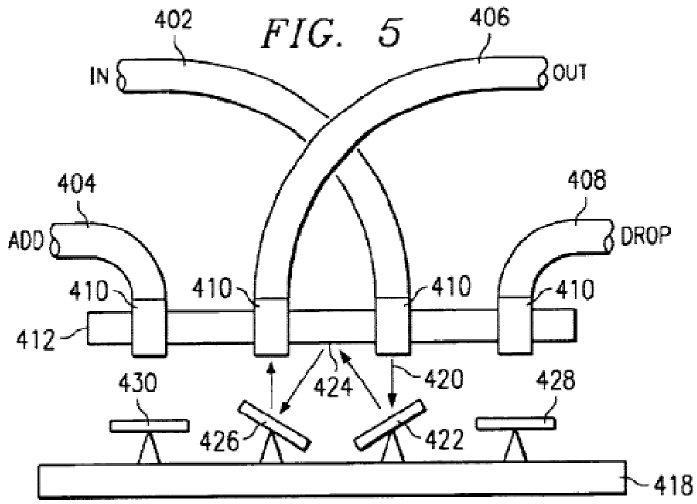
430. Tew ’640 discloses discrete mirrors being free that are operable to pivot about an axis. For example, “the mirror is free to rotate about the axis formed by the torsion hinge. Electrostatic attraction between an address electrode 310 and a deflectable rigid member, which in effect form the two plates of an air gap capacitor, is used to rotate the mirror structure. Depending on the design of the micromirror device, the deflectable rigid member is the torsion beam yoke 314, the beam or mirror 302, a beam attached directly to the torsion hinges, or a combination thereof. The upper address electrodes 324 also electrostatically attract the deflectable rigid member.” Tew ’640 at 7:28-38; *see also* Provisional Application No. 60/236,532 at 14:1-7. Further, Tew ’640 further describes, and Figures 4-8 (shown below) detail that the discrete mirrors as being able to move independent of one another. “The micromirror array 414 of FIG. 4 includes four discrete mirrors 416. Each of the mirrors 422, 426, 428, 430 is operable to tilt clockwise or counterclockwise about an axis perpendicular to the plane of FIG. 4. The supporting structure of the mirrors is not shown, but instead each mirror is illustrated as supported on the tip of a triangle to show that each mirror is operable to tilt in either direction. The mirrors of FIG. 4 are all fabricated on a single substrate 418.” Tew ’640 at 8:32-40; *see also* Provisional Application No. 60/236,532 at 16:1-6.

FIG. 4



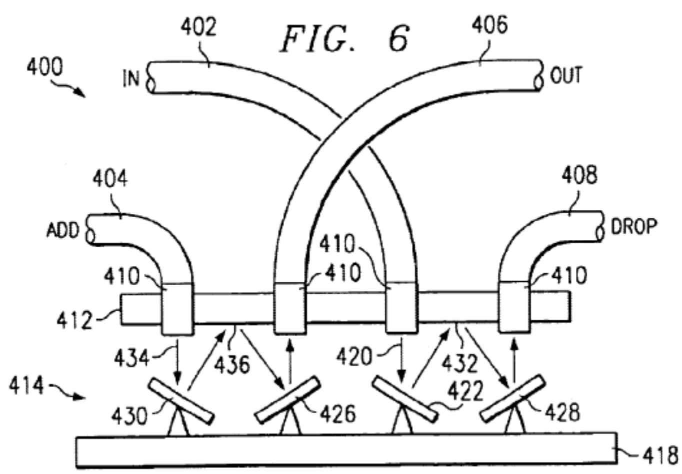
Tew '640 at FIG. 4; *see also* Provisional Application No. 60/236,532 at FIG. 4.

FIG. 5

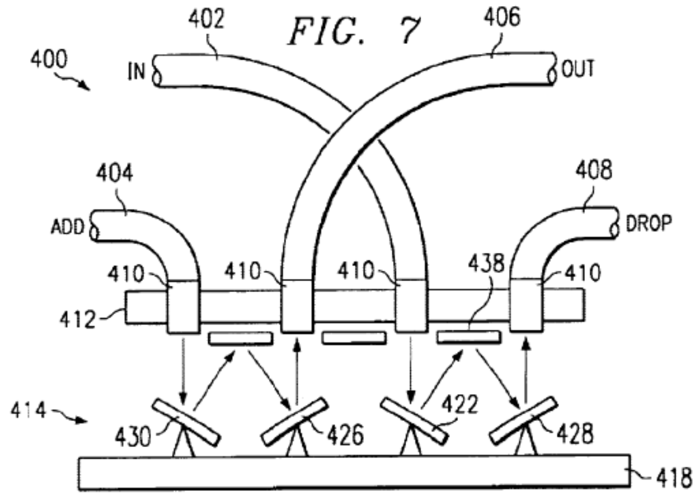


Tew '640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.

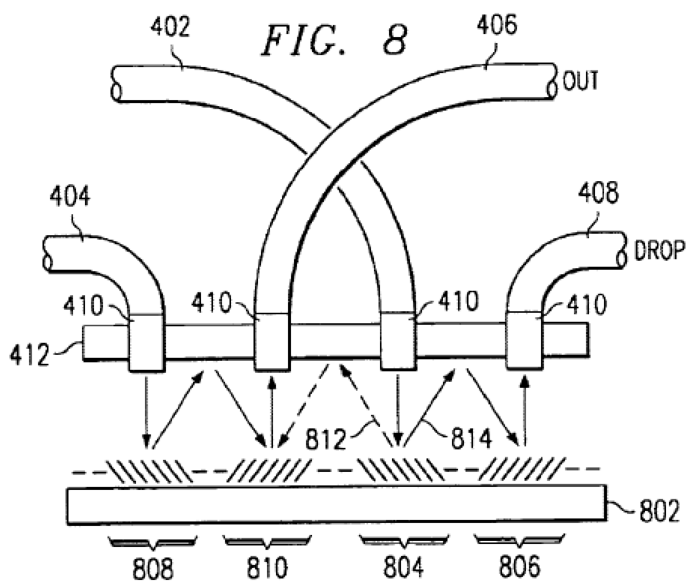
FIG. 6



Tew '640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.



Tew ’640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

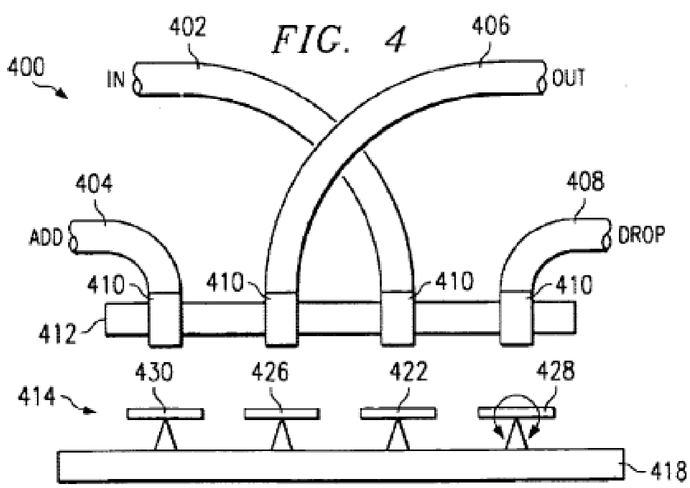
431. Therefore, Tew ’640 discloses to a POSITA “wherein said auxiliary channel micromirrors are individually pivotable.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cviii) *'906 Patent, [129] "The optical system of claim 126 wherein each auxiliary channel micromirror is a silicon micromachined mirror"*

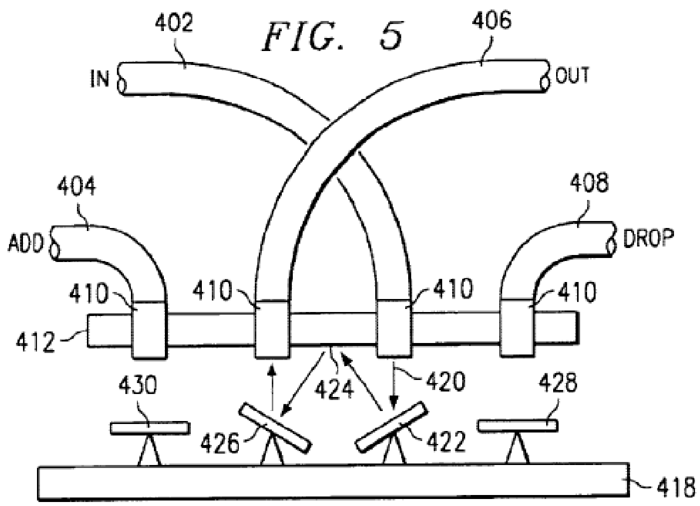
432. Tew '640 discloses to a POSITA "wherein each auxiliary channel micromirror is a silicon micromachined mirror."

433. Tew '640 discloses the mirrors being silicon micromachined mirrors. For example, "[t]he mirrors are silicon, gold, aluminum, or other metals or materials capable of reflecting the signal energy in the wavelengths transmitted by the switch. If the mirrors are sufficiently large, a single mirror is used to reflect each signal. Alternatively, a number of small mirrors are used to collectively reflect the each signal." Tew '640 at 5:19-32; *see also* Provisional Application No. 60/236,532 at 10:3-11; Tew '640 at 55-56 ("The micromirror 300 is fabricated on a semiconductor, typically silicon, substrate 304."). Additionally, as shown in Figures 4-8 (reprinted below), there can be multiple mirrors (e.g., the micromirrors 422, 426, 428, and 430) serving as auxiliary mirrors.

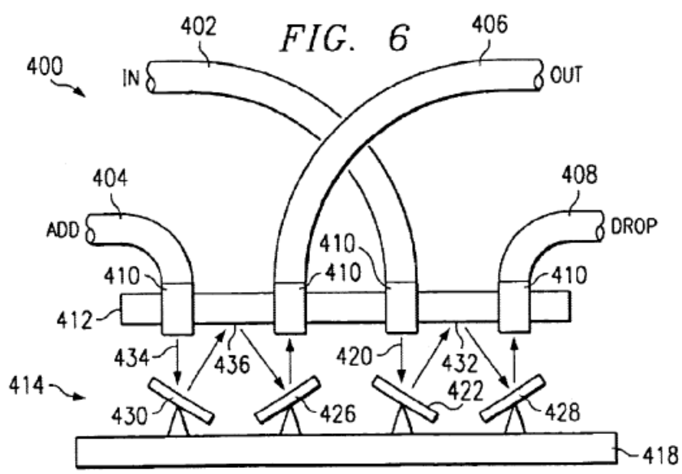
FIG. 4



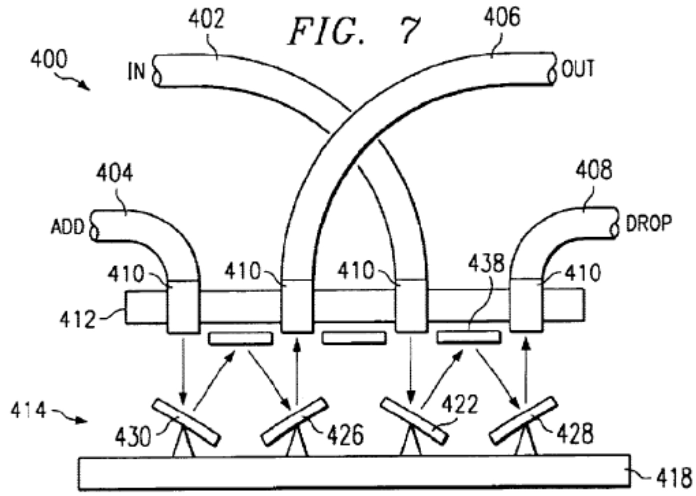
Tew '640 at FIG. 4; *see also* Provisional Application No. 60/236,532 at FIG. 4.



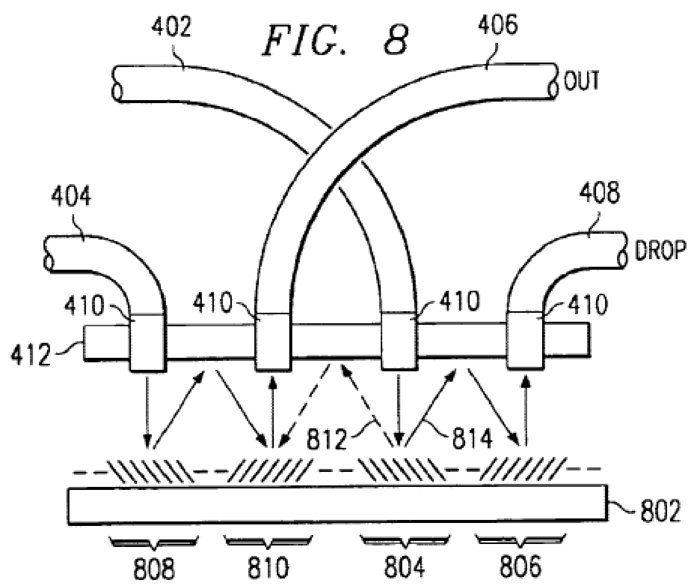
Tew ’640 at FIG. 5; *see also* Provisional Application No. 60/236,532 at FIG. 5.



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.



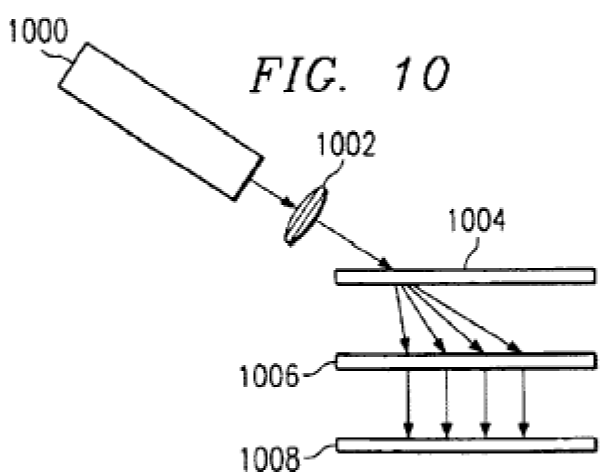
Tew ’640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

434. Therefore, Tew ’640 discloses to a POSITA “wherein each auxiliary channel micromirror is a silicon micromachined mirror.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

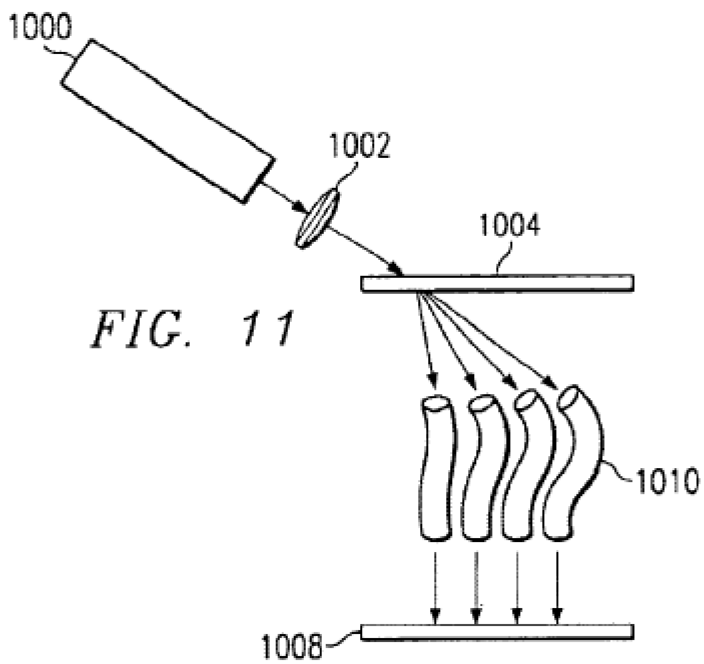
(cix) *'906 Patent, [130] "The optical system of claim 126 wherein said auxiliary wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

435. Tew '640 discloses to a POSITA "wherein said auxiliary wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."

436. Tew '640 discloses an auxiliary beam separator. For example, "[a] light beam entering the OADM through a first input fiber (402) is separated by wavelength to yield multiple light beams (902, 904)." Tew '640 at Abstract; *see also* Provisional Application No. 60/236,532 at Abstract. Further, Figure 10, reprinted below, shows "light from an input fiber 1000 is collimated by an optic 1002 and strikes a beam separator such as diffraction grating 1004. The diffraction grating spatially separates the component beams of the input light beam" (emphasis added). Tew '640 at 10:35-43; *see also* Provisional Application No. 60/236,532 at 19:18-23.



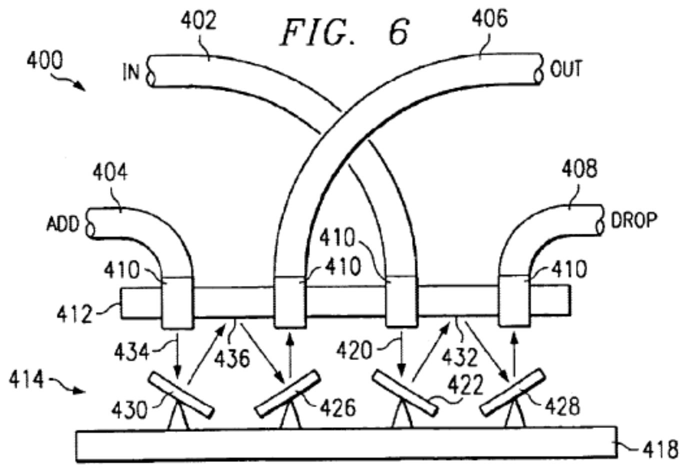
Tew '640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10. Additionally, in Figure 11, reprinted below, the light separated from by the beam separator (diffraction grating 1004) can be individually captured by a number of fibers. For example, "[t]he separated beams are then individually captured by a set of optical fibers 1010. The optical fibers 1010 re-emit the separated light beams to the mirror array 1008." Tew '640 at 10:44-50; *see also* Provisional Application No. 60/236,532 at 20:1-5.



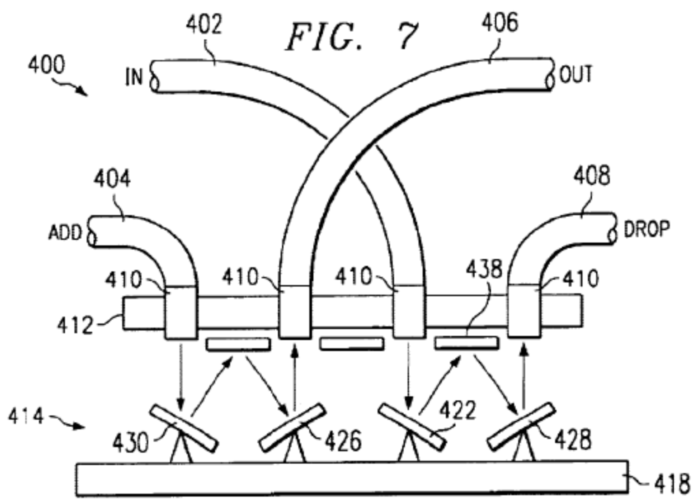
Tew '640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11.

437. Additionally, there can be multiple input fibers. As shown in Figures 6-8 (reproduced below) can provide an auxiliary input (e.g., the add fiber 404) to the first input (e.g., the input fiber 402). For example, "at the same time the light beam 420 from the "in" fiber 402 is being dropped, another light beam 434 is provided to the first output fiber 406. The second light beam 434 exits the second input fiber 404, the "add" fiber."" Tew '640 at 8:65-9:1; *see also* Provisional Application No. 60/236,532 at 17:1-3. Therefore, there can be multiple

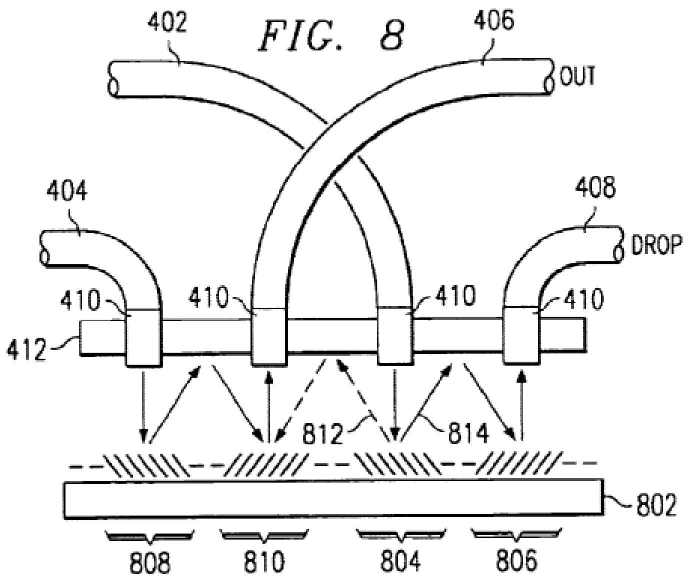
input fibers where at least one fiber (e.g., the add fiber) can serve as an auxiliary wavelength-separator.



Tew ’640 at FIG. 6; *see also* Provisional Application No. 60/236,532 at FIG. 6.



Tew ’640 at FIG. 7; *see also* Provisional Application No. 60/236,532 at FIG. 7.



Tew ’640 at FIG. 8; *see also* Provisional Application No. 60/236,532 at FIG. 8.

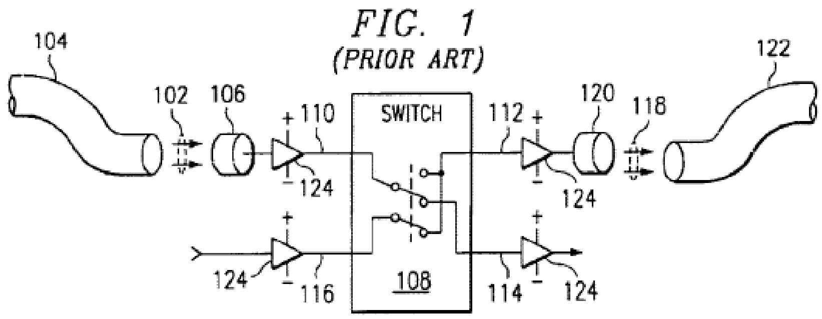
438. Therefore, because there can be multiple inputs, each having its own beam separator, Tew ’640 discloses to a POSITA “wherein said auxiliary wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms.” Even if Tew ’640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cx) *’906 Patent, [131] “The optical system of claim 126 wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports.”*

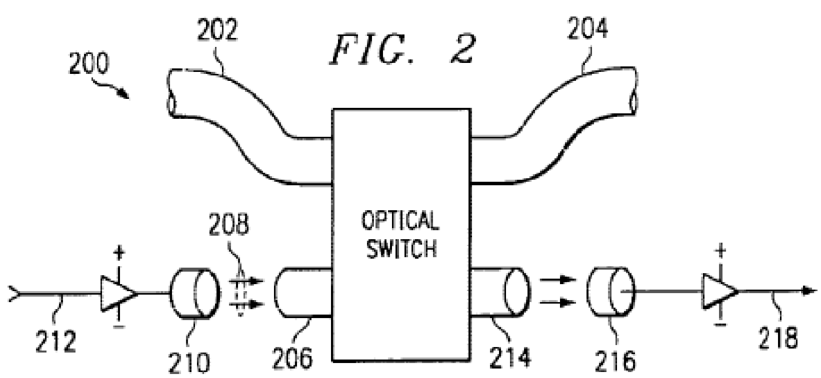
439. Tew ’640 discloses to a POSITA “wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports.”

440. Tew ’640 discloses a pass-through port that can be used to re-transmit a signal. A POSITA would know that to re-transmit a signal is to pass the signal through an input port again. As shown in Figure 1 (reprinted below), “[w]hen the switch is in a first position, the

signal on the first input 110 is passed through to the first output 112 and retransmitted." Tew '640 at 4:30-42; *see also* Provisional Application No. 60/236,532 at 8:12-19.



Tew '640 at FIG. 1; *see also* Provisional Application No. 60/236,532 at FIG. 1. As further described and shown in Figure 2 (reprinted below), "[s]ignals that have yet to reach their intended destination are passed through the first output 204 and continue along the fiber to another node of the network." Tew '640 at 4:66-5:18; *see also* Provisional Application No. 60/236,532 at 9:12-10:2.



Tew '640 at FIG. 2; *see also* Provisional Application No. 60/236,532 at FIG. 2.

441. Therefore, Tew '640 discloses to a POSITA "wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports." Even if Tew '640 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cxi) *'906 Patent, [132] "The optical system of claim 115, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator."*

442. I previously analyzed Tew '640 in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.a.xix (Paragraphs 255-256).

I incorporate that analysis by reference.

(cxii) *'906 Patent, [133] "A method of performing dynamic wavelength separating and routing, comprising"*

443. I previously analyzed Tew '640 in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]"discussed above in Section IX.1.a.xlviii (Paragraphs 307-309).

I incorporate that analysis by reference.

444. Tew '640 discloses steps for using an wavelength-separating-routing apparatus. For example, "An optical switch ideally suited for use as an optical add drop multiplexer (OADM). A light beam entering the OADM through a first input fiber (402) is separated by wavelength to yield multiple light beams (902, 904). One light beam (902) is reflected by one or more of the mirrors in mirror array (908). Depending on the position of the mirrors struck by light beam (902), the beam is reflected to a first region of a retro-reflector (910) or a second region (912). When light beam (902) is reflected by the second region (912) of the retro-reflector, it again travels to the mirror array (908) and is then reflected to a wavelength combiner (914) and output on the second ("drop") output fiber (408). While a first wavelength light beam (902) is reflected to the drop output (408), other wavelengths of light from the first input (402), for example light beam (904), are directed to the "out" optical fiber (406). A first group of mirrors (914) in the array (908) are thus used selectively to switch various wavelengths

of the input optical signal to either the "out" optical fiber (406) or the "drop" optical fiber (408). Another group of mirrors (914) works cooperatively with the first group to direct light beams destined for the "drop" output fiber (408) to the wavelength combiner associated with the "drop" output. Other groups of mirrors operate to switch various wavelengths from the second input (404), the "add" fiber, to the first output "out."" Tew ’640 at Abstract; *see also* Provisional Application No. 60/236,532 at Abstract.

(cxiii) *’906 Patent, [133-a] “receiving a multi-wavelength optical signal from a fiber collimator input port”*

445. I previously analyzed Tew ’640 in view of the following limitations:

- “an output port and fiber collimators serving as an input port and one or more other ports[,]” discussed above in Section IX.1.a.iii (Paragraphs 190-192); and
- “multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]” discussed above in Section IX.1.a.xlix (Paragraphs 310-313).

I incorporate that analysis by reference.

(cxiv) *’906 Patent, [133-b] “separating said multi-wavelength optical signal into multiple spectral channels”*

446. I previously analyzed Tew ’640 in view of the following limitations:

- “a wavelength-selective device for spatially separating said spectral channels[,]” discussed above in Section IX.1.a.vi (Paragraphs 200-202).

I incorporate that analysis by reference.

(cxv) *’906 Patent, [133-c] “focusing said spectral channels onto a spatial array of corresponding beam-deflecting elements, whereby each beam-deflecting element receives one of said spectral channels”*

447. I previously analyzed Tew ’640 in view of the following limitations:

- “a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]” discussed above in Section IX.1.a.xvi (Paragraphs 240-243); and

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels," discussed above in Section IX.1.a.vii (Paragraphs 203-214)

I incorporate that analysis by reference.

(cxvi) *'906 Patent, [133-d] "dynamically and continuously controlling said beam-deflecting elements in two dimensions to direct said spectral channels into any selected ones of output ports and to control the power of the spectral channels coupled into said selected output ports"*

448. I previously analyzed Tew '640 in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214);

- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.a.viii (Paragraphs 215-217);

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.a.ix (Paragraphs 218-221);

- "said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal[,]" discussed above in Section IX.1.a.xiv (Paragraphs 233-235);

- "controlling dynamically and continuously said beam-deflecting elements in two dimensions[,]"discussed above in Section IX.1.a.xli (Paragraphs 291-295);

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port [,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel

micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.a.lii (Paragraphs 320-323)

I incorporate that analysis by reference.

(cxvii) *'906 Patent, [134] "The method of claim 133 further comprising the step of providing feedback control of said beam-deflecting elements to maintain a predetermining coupling of each spectral channel directed into one of said output ports."*

449. I previously analyzed Tew '640 in view of the following limitations:

- "a spatial array of beam-deflecting elements[,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214);
- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.a.ix (Paragraphs 218-221);
- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.a.x (Paragraph 222);
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.a.xxii (Paragraphs 262); and
- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.a.liii (Paragraphs 324-325).

I incorporate that analysis by reference.

> **(cxviii)** *'906 Patent, [135] "The method of claim 134 further comprising the step of maintaining power levels of said spectral channels directed into said output ports at a predetermining value."*

450. I previously analyzed Tew '640 in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.a.ix (Paragraphs 218-221); and
- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.a.x (Paragraph 222).

I incorporate that analysis by reference.

> **(cxix)** *'906 Patent, [137] "The method of claim 133 wherein a subset of said spectral channels is directed into one of said output ports, thereby providing one or more pass-through spectral channels."*

451. I previously analyzed Tew '640 in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.a.vii (Paragraphs 203-214);
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.a.lii (Paragraphs 320-323); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and

continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels[,]"discussed above in Section IX.1.a.xciii (Paragraph 405).

I incorporate that analysis by reference.

(cxx) *'906 Patent, [138] "The method of claim 137 further comprising the step of multiplexing said pass-through spectral channels with one or more add spectral channels, so as to provide an output optical signal."*

452. I previously analyzed Tew '640 in view of the following limitations:

- "wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors [,]"discussed above in Section IX.1.a.cvi (Paragraph 428).

I incorporate that analysis by reference.

(cxxi) *'906 Patent, [139] "The method of claim 133 wherein said beam-deflecting elements comprise an array of silicon micromachined mirrors."*

453. I previously analyzed Tew '640 in view of the following limitations:

- "a spatial array of beam-deflecting elements[,]"discussed above in Section IX.1.a.vii (Paragraphs 203-214);
- "a spatial array of channel micromirrors[,] discussed above in Section IX.1.a.lii (Paragraphs 320-323); and
- "wherein each channel micromirror is a silicon micromachined mirror[,]" discussed above in Section IX.1.a.lvii (Paragraphs 332-334).

I incorporate that analysis by reference.

b) U.S. Patent No. 6,798,941 ("Smith")

454. Smith provides "[a] multi-wavelength or white-light optical switch including an array of mirrors tiltable about two axes, both to control the switching and to provide variable power transmission through the switch, both for optimization and for power equalization between wavelength channels in a multi-wavelength signal." *See* Smith at Abstract. Smith further discloses "a WDM add/drop multiplexer (WADM) in which the input ports IN, IN are associated respectively with the input (IN) port of the transmission fiber and the DROP port to the local node and the output ports OUT, OUT are associated respectively with the output (OUT) port of the transmission fiber and the ADD port from the local node." *See id.* at 8:53-59. This configuration is depicted in Figure 8, reproduced below.

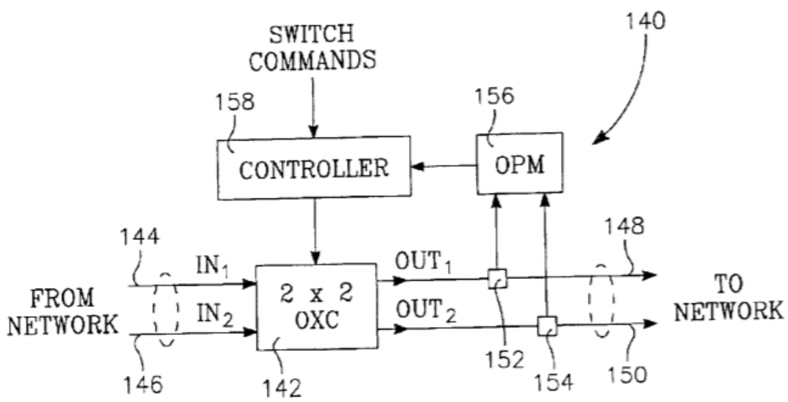


FIG. 8

455. With reference to Figure 9, reproduced below, Smith explains that "the four fibers 162, 164, 166, 168 correspond respectively, for example, to IN, OUT, ADD, and DROP" and that "[a]n NxN cross connect can be implemented by increasing the numbers of fibers and planar waveguides although it is appreciated that this enlargement additionally constrains the design of the rest of the system." *See id.* at 12:4-12, Fig. 9. Smith further explains that "the outputs of the four planar waveguides 172-178 are placed at or near the focal point of a collimating lens system 188," that "[t]he collimated beams, which propagate substantially

within a common plane, are incident upon a diffraction grating 190 having grating lines extending parallel to the plane of the illustration so that the wavelength components are angularly separated perpendicularly to the plane of the illustration," and that "[t]he beams may overlap when they strike the grating 190, which wavelength separates the four beams into corresponding sets of wavelength-separated beams, only one set of which is illustrated." *See id.* at 12:29-42. Thereafter, "[a] lens system 202 focuses the beams onto a MEMS mirror array 204, placing the gaussian waists of the beams at the mirror surfaces." *See id.* at 12:43-45. "The MEMS mirror array 204 of the illustrated system includes both input mirrors and output mirrors for each channel through the switch, that is, two input mirrors and two output mirrors for each wavelength for the illustrated four-fiber system which includes two input fibers and two output fibers," and "[t]he input and output mirrors are controlled in pairs to selectively direct the wavelength-separated optical signal from one of the input fibers 162, 164 to one of the output fibers 166, 168." *See id.* at 12:45-50, 13:3-6.

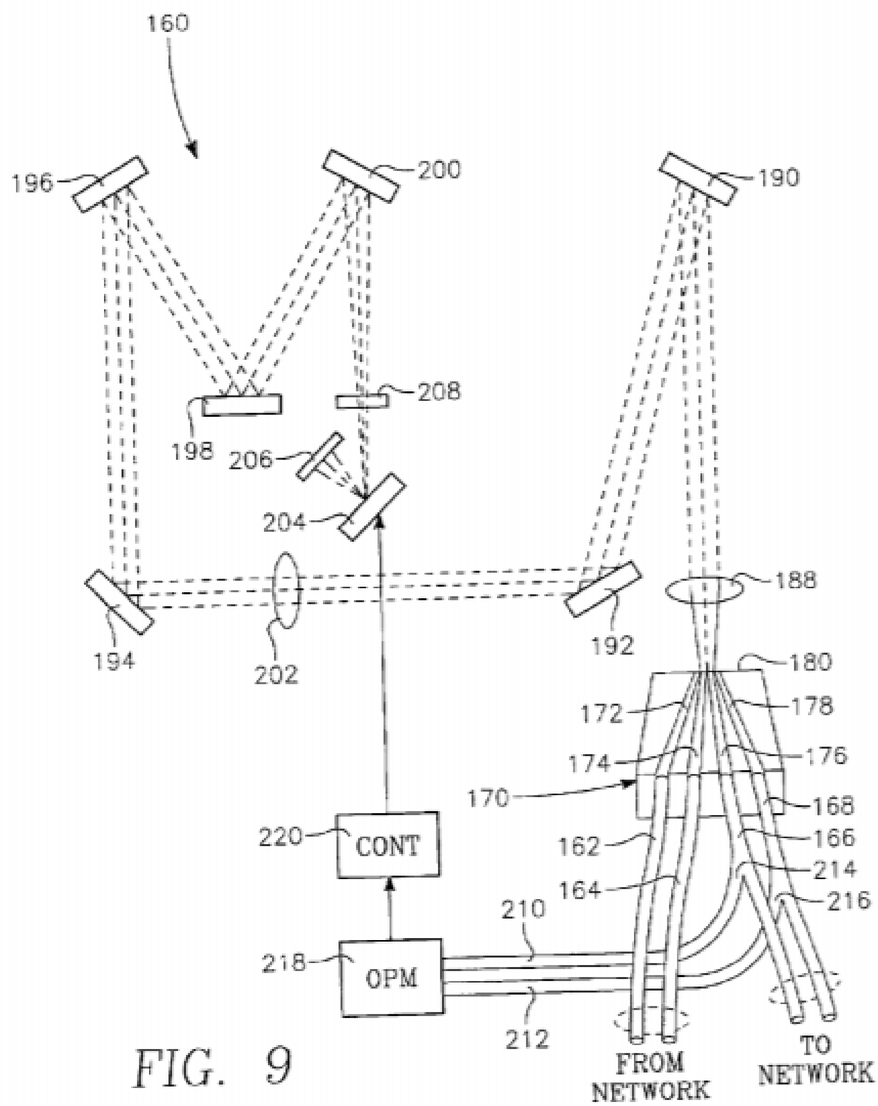


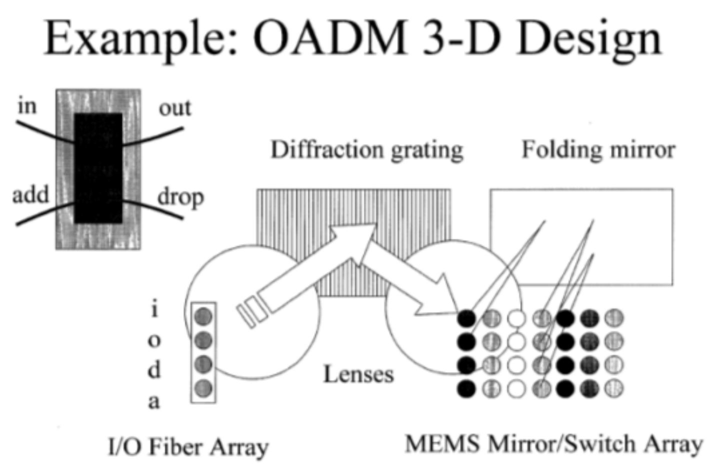
FIG. 9

(i) *Smith Is Prior Art to the Asserted Claims*

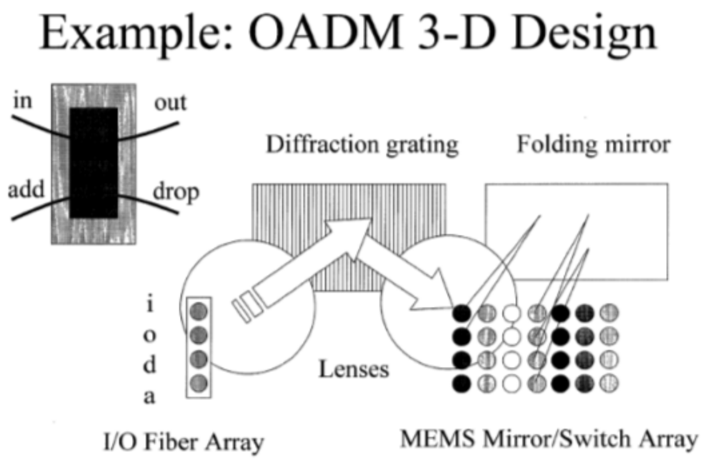
456. Smith claims priority to U.S. Provisional Application No. 60/234,683 ("Smith Prov."), filed Sep. 22, 2000, and U.S. Provisional Application No. 60/267,285, filed Feb. 7, 2001, was filed on September 20, 2001, was published as U.S. Patent Publication No. 2002/0071627 on June 13, 2002, and issued on September 28, 2004.

457. I understand that Smith is entitled to the priority date of Smith Prov. if at least one claim in Smith is supported by the disclosure of Smith Prov. At least claim 1 of Smith is supported by the disclosure of Smith Prov. With respect to the preamble, which sets forth "[a]n

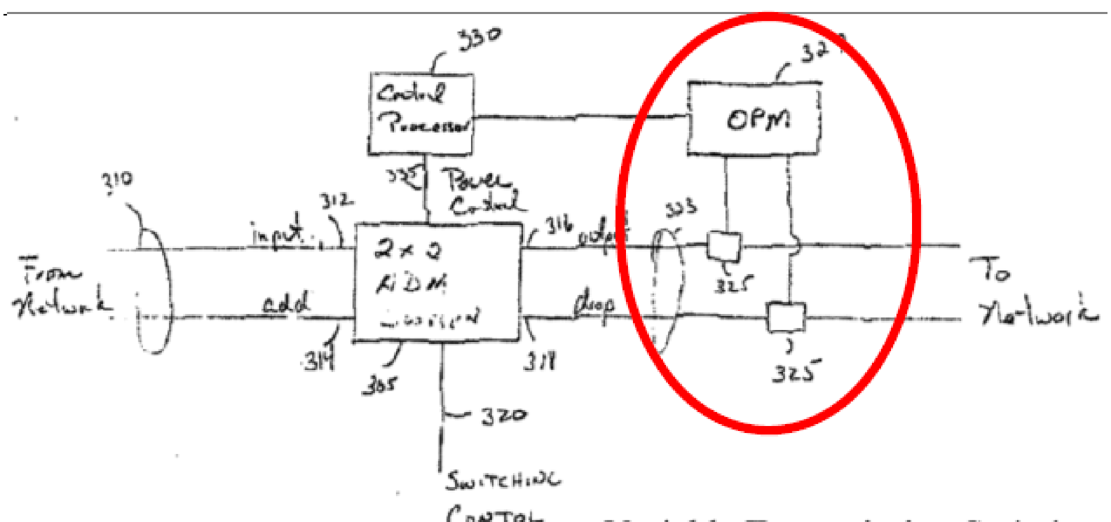
optical switching system," Smith Prov. discloses that "[s]ignals may enter the switch through the input port 110 or add port 114 and exit through the drop port 116 and/or output port 112." *See* Smith Prov. at 7:9-11; *see also id.* at 7:7-8, 7:17-19. Smith Prov. also explains that "signals in each wavelength channel are routed to the output 316 and drop 318 ports under the control of the electronic switching input signal 320." *See id.* at 11:2-4. Furthermore, Figure 6, reproduced below, depicts a MEMS mirror/switch array. *See id.* at Fig. 6; *see also id.* at Figs. 2, 5, 9.



458. With respect to the "at least one movable mirror for selectively coupling an optical signal from an input port to any of a plurality of output ports according to a position of said mirror" limitation, Smith Prov. explains that "the optical throughput of each wavelength channel may be controlled by using ***a mirror array*** with elements that can be rotated in an analog fashion about two orthogonal axes. ***Angular displacement in a first, switching plane, is used to perform an OXC, ADM or other switching function*** while angular displacement about the orthogonal axis is used for power control." *See id.* at 6:3-7 (emphasis added). Figure 6 of Smith Prov., reproduced below, depicts MEMS mirror array. *See id.* at Fig. 6; *see also id.* at Figs. 2, 5, 9.



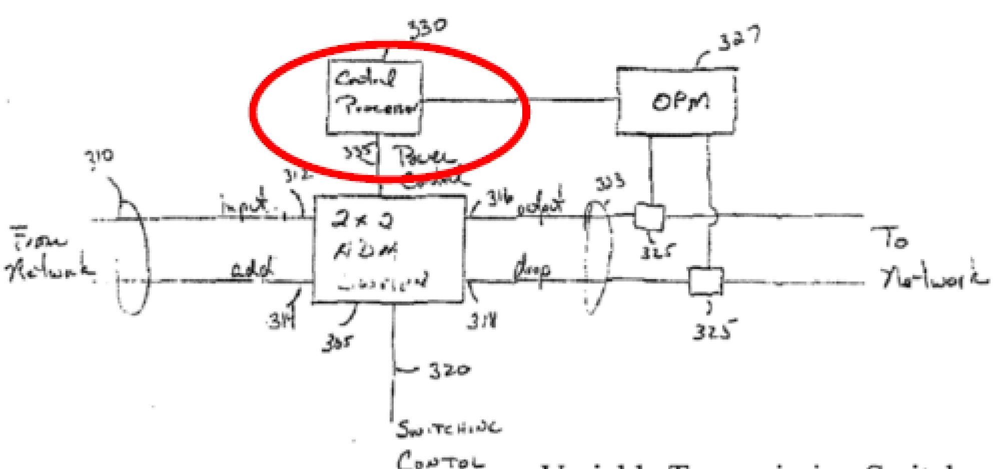
459. With respect to the "an optical detector receiving a portion of light coupled to one of said output ports to measure an intensity of said light" limitation, Smith explains that "the percentage of the drop beam that is coupled into the power drop channel 230 of the optical concentrator 235 may be varied by tilting the individual array elements about their horizontal or vertical axes." *See id.* at 9:25-27; *see also id.* at Figs. 7, 9-11. Figure 4, annotated below, depicts the optical detector. *See id.* at Fig. 4; *see also id.* at Fig. 11.



Variable Transmission Switch
Figure 4

460. With respect to the "a controller receiving an output of said optical detector and in response adjusting said position of said mirror to effect control of said intensity" limitation,

Smith Prov. explains that "the current invention is capable of providing programmable power control to adapt to all system requirements." *See id.* at 11:18-20. Smith Prov. further explains that "to control the power of the beams leaving the switch via the output and drop ports, the corresponding micro-mirror elements are designed to tilt about a second, perpendicular axis in the plane of the array. Tilting a pair of elements about this axis translates the corresponding beam on the surface of the optical concentrator, thereby decreasing the percentage of the light coupled out of the switch." *See id.* at 9:4-8. Smith Prov. also notes that "[t]his resulting feedback loop may be used to actively optimize the power spectra of the signals leaving the ADM switch" and that "one would prefer to maximize the power on each channel, but, for reasons of system uniformity, it is preferred to equalize the powers of all channels which are within a specified range of power (some too-low or too-high power signals may need correction outside the proposed means – e.g. dead lasers) which means adjusting all channel powers until the equal the weakest acceptable channel power this is common in the current art." *See id.* at 11:11-18. Figure 4, annotated below, depicts the controller. *See id.* at Fig. 4; *see also id.* at Figs. 10, 11.



Variable Transmission Switch
Figure 4

461. Accordingly, Smith is prior art to the ’905 Patent under at least pre-AIA 35 U.S.C. § 102(e).

462. I have reviewed the transcript of the deposition of Fariborz Farhan, a named inventor of Smith. I incorporate that deposition transcript into my analysis herein. For example, Mr. Farhan testified that the optical power monitor and controller disclosed in Smith could be used in other optical systems at the time:

> Q. And could I take the optical power monitor and controller that’s depicted here in Figure 9 and use them in optical switches with optical layouts that are different from that depicted Figure 9?
>
> MR. BECKER: Object. Form.
>
> THE WITNESS: The OPM is a generic OPM, meaning it doesn't -- it's independent of the switching system. The OPM is -- allows you to measure, you know, power at the -- each individual wavelength. It is generic in that terms, and it could be used for any -- any of these systems. If the purpose is to measure power level at each individual wavelength, that’s what the OPM will do. So, yes, you should be able to.

Fariborz Farhan Depo Tr. at 40:22–41:10.

463. Mr. Farhan also testified that the attenuation described in Smith may be used for power equalization and performance optimization of the optical system:

> Q And why would you misalign the beam as is being shown in Figure 17?
>
> MR. BECKER: Object. Form.
>
> THE WITNESS: Well, its -- it’s basically you can do it purposely and you can do it -- either you want to attenuate it or it's basically an effect of your design. So, you know, if it's beamed unintentionally, it’s because you’re trying to create a little attenuation of the signal, and that’s intentional; and, if you’re not, it’s just because of your optical design, you haven’t aligned the beams correctly. So the -- you know, if you are -- your intent is to go to have almost no attenuation, you know, zero dB through -- through loss, you know, this is not the way to do it, you know, but if you are intending to do it, then you’re -- you have two methods, and I think this paragraph is basically describing what the -- the merits of each are.
>
> BY MR. GAUSTAD: Q And why would I want to attenuate the signal?

MR. BECKER: Object. Form.

THE WITNESS: Well, like I -- I was basically going back to the earlier discussion, you know, for the -- what we call power equalization, which then would lead to optimization, optimization of the transmission system, the optimization in the performance, performance optimization of the transmission system.

Id. at 53:16–54:21.

(ii) *'905 Patent, [23-pre]: "An optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports, the apparatus comprising"*

464. Under Capella's apparent interpretation, Smith discloses to a POSITA "[a]n optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports." For example, Smith discloses "a WDM add/drop multiplexer (WADM) in which the input ports IN, IN are associated respectively with the input (IN) port of the transmission fiber and the DROP port to the local node and the output ports OUT, OUT are associated respectively with the output (OUT) port of the transmission fiber and the ADD port from the local node." *See* Smith at 8:53-59, Fig. 8; *see also* Smith Prov. at 2:9-13, 4:9-17, 7:6-18, Figs. 1-6. This configuration is depicted in Figure 8, reproduced below.

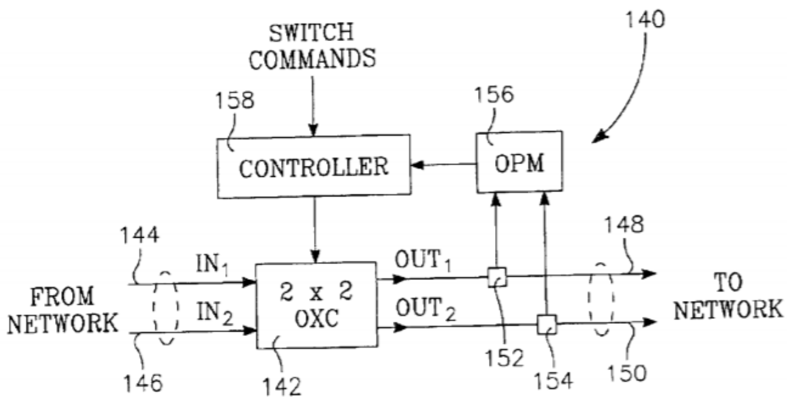


FIG. 8

465. With reference to Figure 9, reproduced below, Smith explains that "[f]or an add/drop multiplexer, the four fibers 162, 164, 166, 168 correspond respectively, for example,

to IN, OUT, ADD, and DROP" and that "[a]n NxN cross connect can be implemented by increasing the numbers of fibers and planar waveguides although it is appreciated that this enlargement additionally constrains the design of the rest of the system." *See* Smith at 12:4-12, Fig. 9; *see also id.* at 12:29-42, Figs. 10-13; *see also* Smith Prov. at 2:9-13, 4:9-17, 7:6-18, Figs. 1-6. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

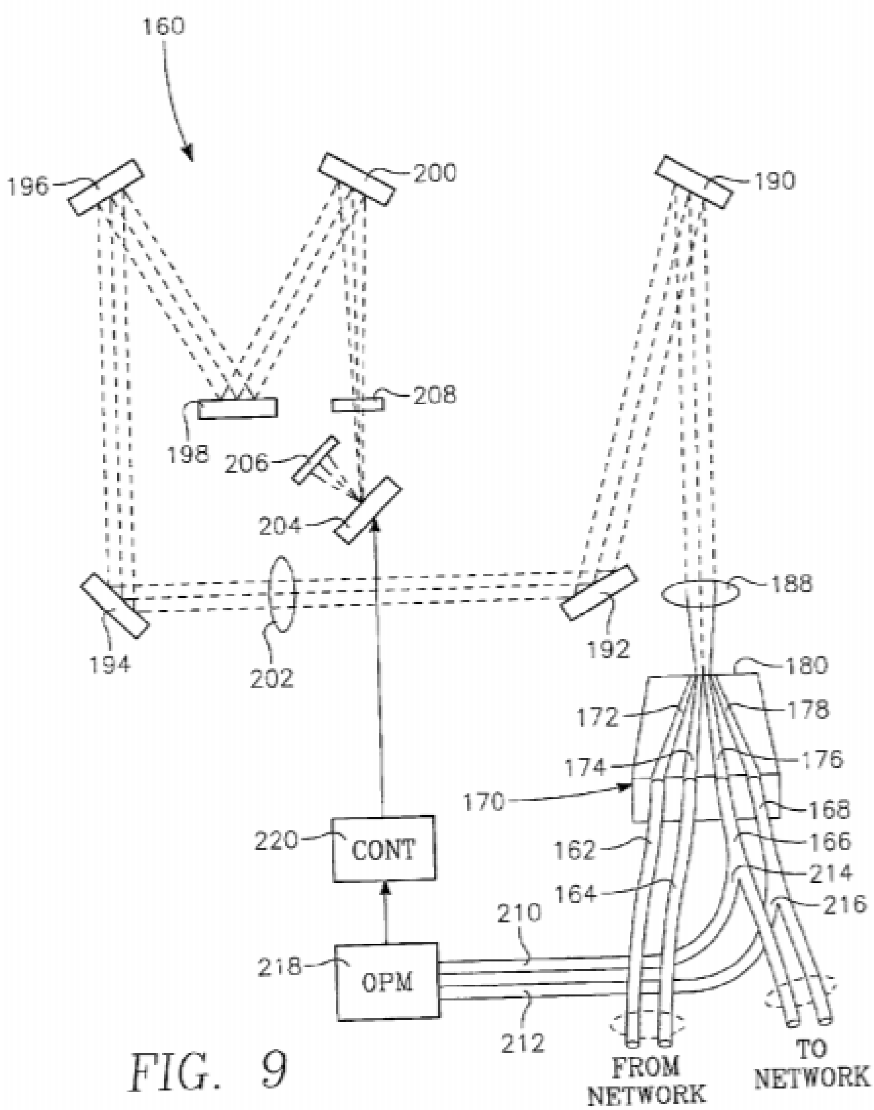


FIG. 9

466. Therefore, under Capella's apparent interpretation, Smith discloses to a POSITA "[a]n optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports."

(iii) *'905 Patent, [23-a] "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels"*

467. Under Capella's apparent interpretation, Smith discloses to a POSITA "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels." For example, with reference to Figure 9, reproduced below, Smith explains that "the outputs of the four planar waveguides 172-178 are placed at or near the focal point of ***a collimating lens system 188***. The collimated beams, which propagate substantially within a common plane, are incident upon a diffraction grating 190 having grating lines extending parallel to the plane of the illustration so that the wavelength components are angularly separated perpendicularly to the plane of the illustration. The beams may overlap when they strike the grating 190, which wavelength separates the four beams into corresponding sets of wavelength-separated beams, only one set of which is illustrated. Various mirrors 192,194,196, 198,200 are included to condense the overall size of the system with little significant influence on the overall operation." *See* Smith at 12:29-42 (emphasis added), Fig. 9; *see also id.* at 3:66-4:24, Fig. 5; *see also* Smith Prov. at 3:16-4:3, 7:19-8:4, FIG. 1. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

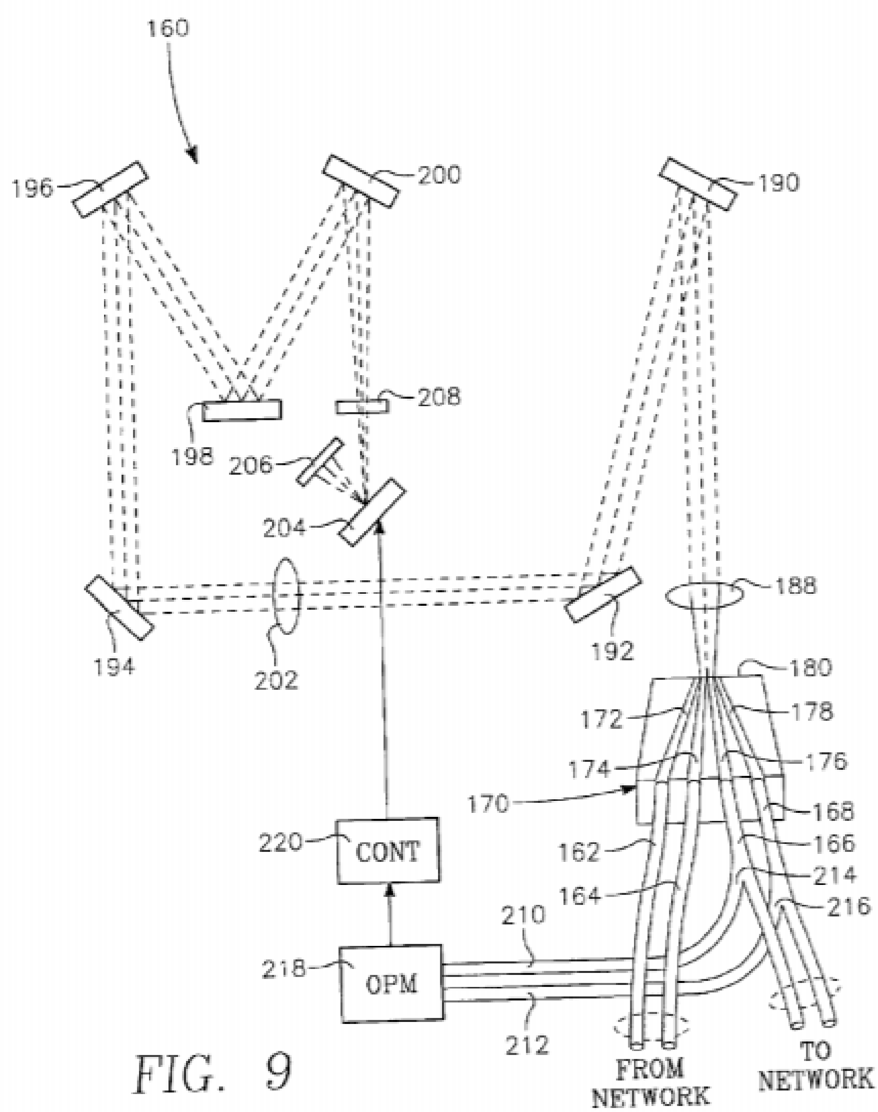


FIG. 9

468. Therefore, under Capella's apparent interpretation, Smith discloses to a POSITA "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels."

(iv) *'905 Patent, [23-b] "the fiber collimator one or more other ports for second spectral channels"*

469. Under Capella's apparent interpretation, Smith discloses to a POSITA "the fiber collimator one or more other ports for second spectral channels." For example, with reference to Figure 9, reproduced below, Smith explains that "the outputs of the four planar waveguides

172-178 are placed at or near the focal point of ***a collimating lens system 188***. The collimated beams, which propagate substantially within a common plane, are incident upon a diffraction grating 190 having grating lines extending parallel to the plane of the illustration so that the wavelength components are angularly separated perpendicularly to the plane of the illustration. The beams may overlap when they strike the grating 190, which wavelength separates the four beams into corresponding sets of wavelength-separated beams, only one set of which is illustrated. Various mirrors 192, 194, 196, 198, 200 are included to condense the overall size of the system with little significant influence on the overall operation." *See* Smith at 12:29-42 (emphasis added), Fig. 9; *see also id.* at 3:66-4:24, Fig. 5; *see also* Smith Prov. at 3:16-4:3, 7:19-8:4, FIG. 1. A POSITA would understand that the collimated lens system could receive both first and second spectral channels. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

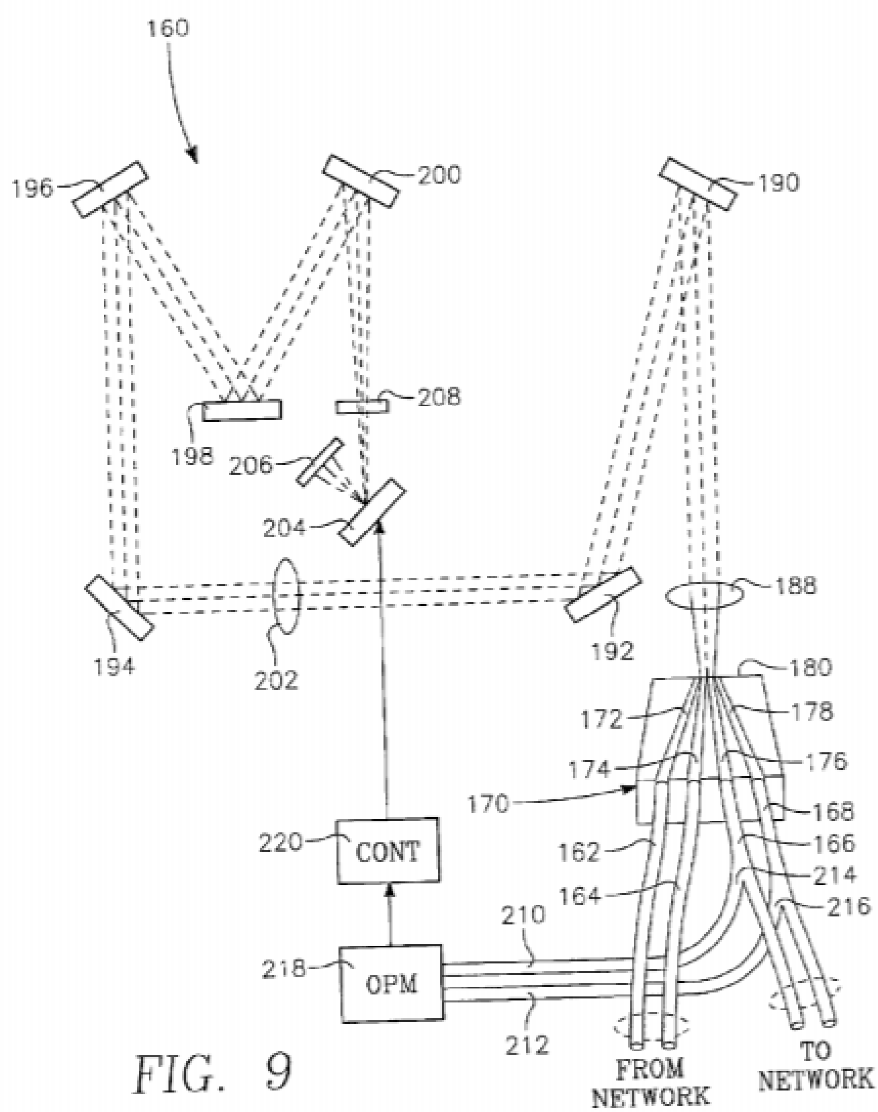


FIG. 9

470. Furthermore, Smith explains that "the invention is directly applicable to a larger number of input and output fibers." *See* Smith at 8:45-46. A POSITA would understand that a system with a larger number of input and output fibers would also have a larger number of fiber collimators.

471. Therefore, under Capella's apparent interpretation, Smith discloses to a POSITA "the fiber collimator one or more other ports for second spectral channels."

(v) *'905 Patent, [23-c] "the output port for an output multi-wavelength optical signal"*

472. Smith discloses to a POSITA "the output port for an output multi-wavelength optical signal." For example, Smith explains, with reference to Figure 8, reproduced below, that "[a] 2x2 optical cross connect (OXC) 142 links two input fibers 144, 146 connected to input ports IN, IN to two output fibers 148, 150 connected to ***output ports*** OUT, OUT." *See* Smith at 8:40-46, Fig. 8 (emphasis added); *see also id.* at 8:47-59, 12:4-12, Figs. 9-13; *see also* Smith Prov. at 3:18-22, 4:18-21, 7:25-8:1, FIGS. 1, 6, 8-10.

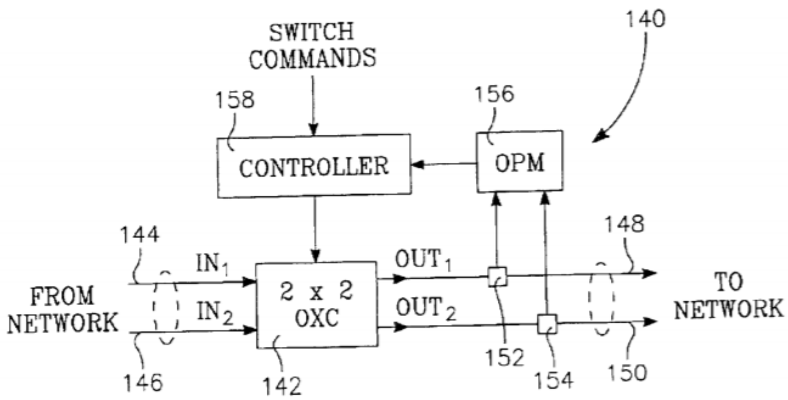


FIG. 8

473. Therefore, Smith discloses to a POSITA "the output port for an output multi-wavelength optical signal."

(vi) *'905 Patent, [23-d] "a wavelength-selective device for spatially separating said spectral channels"*

474. Smith discloses to a POSITA "a wavelength-selective device for spatially separating said spectral channels." For example, with reference to Figure 9, reproduced below, Smith explains that "the outputs of the four planar waveguides 172-178 are placed at or near the focal point of a collimating lens system 188. The collimated beams, which propagate substantially within a common plane, are incident upon ***a diffraction grating 190*** having grating lines extending parallel to the plane of the illustration so that the wavelength components are

angularly separated perpendicularly to the plane of the illustration. The beams may overlap when they strike the ***grating 190, which wavelength separates the four beams into corresponding sets of wavelength-separated beams,*** only one set of which is illustrated. Various mirrors 192,194,196, 198,200 are included to condense the overall size of the system with little significant influence on the overall operation." *See* Smith at 12:29-42 (emphasis added), Fig. 9; *see also id.* at 4:16-29, 5:38-43, Figs. 5, 6, 11, 13; *see also* Smith Prov. at 3:18-22, 4:18-21, 7:25-8:1, FIGS. 1, 6, 8-10.

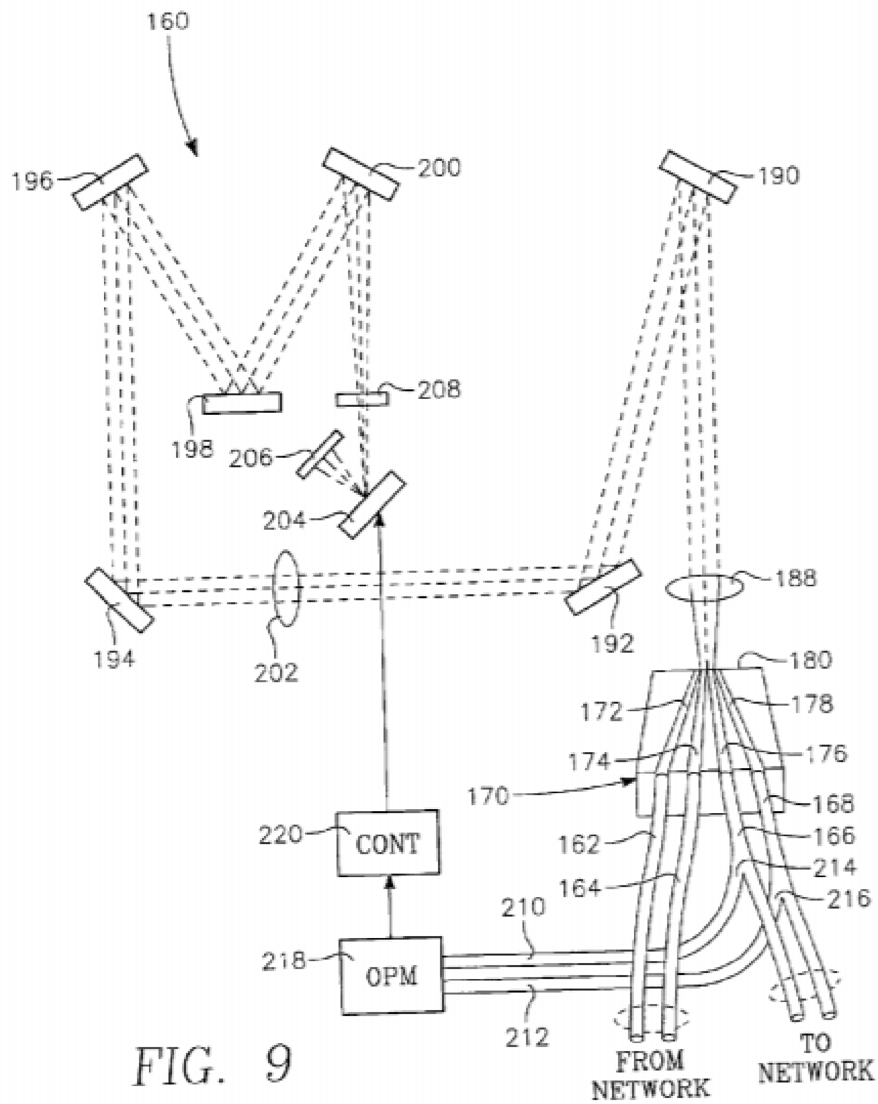


FIG. 9

475. Therefore, Smith discloses to a POSITA "a wavelength-selective device for spatially separating said spectral channels."

(vii) *'905 Patent, [23-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port"*

476. Smith discloses to a POSITA "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port." For example, Smith provides "[a] multi-wavelength or white-light optical switch including ***an array of mirrors tiltable about two axes***, both to control the switching and to provide variable power transmission through the switch, both for optimization and for power equalization between wavelength channels in a multi-wavelength signal." *See* Smith at Abstract (emphasis added); *see also id.* at 4:40-42, 4:56-60, Figs. 5, 6; *see also* Smith Prov. at 3:16-24, 6:3-7, 7:29-8:2, 8:5-11, 9:4-23, 10:1-20, Figs. 1-3, 6, 7. Figure 14, reproduced below "is plan view of two-axis tiltable mirror usable with the invention." *See* Smith at 8:19-20, Fig. 14; *see also* Smith Prov. at 3:16-24, 6:3-7, 7:29-8:2, 8:5-11, 9:4-23, 10:1-20, Figs. 1-3, 6, 7.

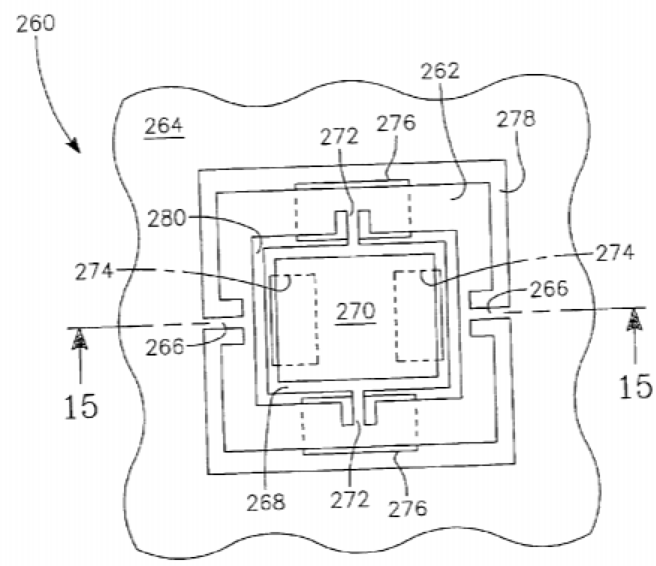


FIG. 14

477. The mirrors in Smith are individually and continuously controllable in two dimensions. For example, Smith explains that "[t]he MEMS array 204 is preferably formed as a two dimensional array of ***dual-axis tiltable mirrors***" and "includes a gimbal structure of an outer frame 262 twistably supported in a support structure 264 of the MEMS array through a first pair of torsion beams 266 extending along and ***twisting about a minor axis*** [and] a mirror plate 268 having a reflective surface 270 twistably supported on the outer frame 262 through a second pair of torsion beams 272 ***arranged along a major axis perpendicular to the minor axis and twisting thereabout***." *See* Smith at 14:49-65 (emphasis added) ; *see also* Smith at 15:35-54; *see also* Smith Prov. at 3:16-24, 6:3-7, 7:29-8:2, 8:5-11, 9:4-23, 10:1-20, Figs. 1-3, 6, 7.

478. Additionally, the mirrors in Smith reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports. Smith explains that "[t]he MEMS mirror array 204 of the illustrated system includes both input mirrors and output mirrors for each channel through the switch, that is, ***two input mirrors and two output mirrors for each wavelength for the illustrated four-fiber system which includes two input fibers and two***

output fibers." *See* Smith at 12:39-50 (emphasis added); *see also* Smith Prov. at 3:16-24, 6:3-7, 7:29-8:2, 8:5-11, 9:4-23, 10:1-20, Figs. 1-3, 6, 7. With reference to Figure 16, reproduced below, Smith explains that "an input beam 290 is incident upon a first input mirror 260 and is reflected therefrom to the fold mirror 206" and therefrom "strikes either a first output mirror 260 or a second output mirror 260 to produce respective a first output beam 292 or a second output beam 294." *See* Smith at 16:9-35, Fig. 16; *see also id.* at19:51-55; *see also* Smith Prov. at 3:16-24, 6:3-7, 7:29-8:2, 8:5-11, 9:4-23, 10:1-20, Figs. 1-3, 6, 7.

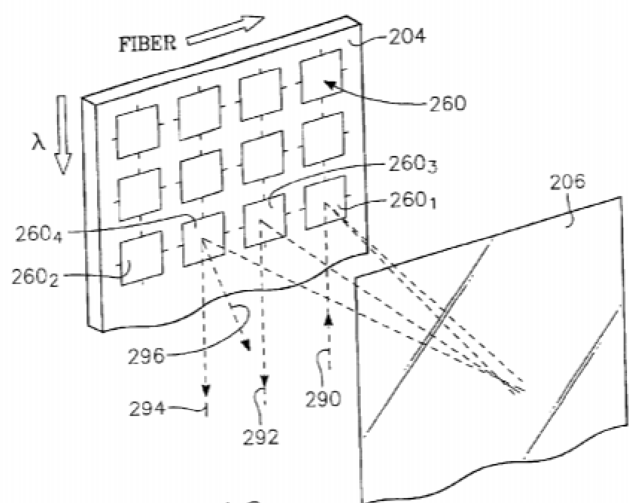


FIG. 16

479. The mirrors in Smith also control the power of the spectral channel reflected to said output port or the fiber collimator selected port. Smith explains:

> The minor axis tilt may also be used for optimizing transmission through the optical switch. After the position of maximum transmission is established, the transmission may be detuned. An example of two-axis switching is the use of a major axis optimized for switching between fibers and ***a minor axis for adjusting transmission, especially insertion loss, of the same optical channel***. Another example is the use of a coarse control of one or more major axes for establishing a switch state connection in combination with ***a fine control along one or more minor axes (which may or may not be the same as the major axes) to moderate the degree of coupling of a wavelength channel between the chosen fibers for that wavelength service***.

See Smith at 7:32-44 (emphasis added); *see also* Smith Prov. at 3:16-24, 6:3-7, 7:29-8:2, 8:5-11, 9:4-23, 10:1-20, Figs. 1-3, 6, 7. Smith further explains that the minor axis "can be used for ***power adjustment*** as well as for tuning for instrumental effects in the optical components." *See* Smith at 16:36-51; *see also* Smith Prov. at 3:16-24, 6:3-7, 7:29-8:2, 8:5-11, 9:4-23, 10:1-20, Figs. 1-3, 6, 7.

480. Therefore, Smith discloses to a POSITA "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port."

(viii) *'905 Patent, [24] "The optical add-drop apparatus of claim 23 further comprising a control unit for controlling each of said beam-deflecting elements"*

481. Smith discloses to a POSITA "a control unit for controlling each of said beam-deflecting elements." For example, Smith discloses "[a] controller 220 [that] receives the outputs of the optical power monitor 218, or more specifically the detected optical intensities of the detector array, and accordingly readjusts the tilt positions of the micromirrors in the MEMS array." *See* Smith at 13:21-24; *see also* Smith Prov. at 7:3-4, 11:2-11, Figs. 4, 11. Specifically, Smith explains that "the optical power monitor 156 preferably measures the power on each of the WDM channels, and the controller 158 accordingly adjusts the power transmission for that wavelength channel through the cross connect 142." *See* Smith at 9:20-33; *see also id.* at 11:13-35, 18:42-53, Figs. 11-13; *see also* Smith Prov. at 7:3-4, 11:2-11, Figs. 4, 11.

482. Therefore, Smith discloses to a POSITA "a control unit for controlling each of said beam-deflecting elements."

(ix) *'905 Patent, [25] "The optical add-drop apparatus of claim 24, wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements"*

483. Smith discloses to a POSITA "wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements." For example, Smith discloses "[a] portion of the switched output signal [that] may be diverted to an optical power monitor to enable feedback control of the power adjustment" and that "[d]ynamic power equalization advantageously involves monitoring of power levels for the individual WDM wavelength channels on each fiber in the system [to] provide[] feedback for the power equalization mechanism." *See* Smith at 7:24-31; *see also* Smith at 13:20-14:15, Fig. 12; *see also* Smith Prov. at 6:10-14, 11:4-23, Fig. 4. Smith further explains that "the optical power monitor 156 preferably measures the power on each of the WDM channels, and the controller 158 accordingly adjusts the power transmission for that wavelength channel through the cross connect 142." *See* Smith at 9:29-33; *see also* Smith Prov. at 6:10-14, 11:4-23, Fig. 4. Specifically, Smith explains that "[e]ach time an input optical signal is routed to a new output fiber, the microprocessor reads the optimum position settings for both axes of both the input and output mirrors associated with this routing combination and sets the mirror positions accordingly." *See* Smith at 18:42-53; *see also* Smith Prov. at 6:10-14, 11:4-23, Fig. 4. Figure 8, reproduced below, "is a block diagram of an optical switching system including an optical power monitor and feedback control." *See* Smith at 8:3-4, Fig. 8; *see also* Smith Prov. at 6:10-14, 11:4-23, Fig. 4. These teachings of an optical power monitor and feedback control are sufficient to disclose to a POSITA a servo-control assembly.

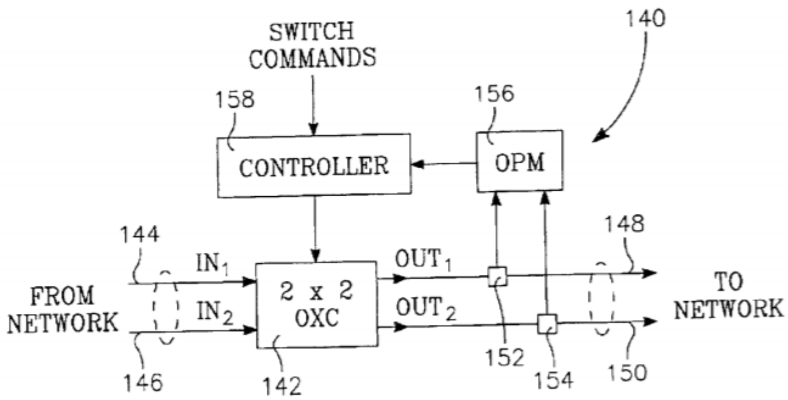


FIG. 8

484. Therefore, Smith discloses to a POSITA "wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements."

(x) *'905 Patent, [26] "The optical add-drop apparatus of claim 25, wherein said servo-control assembly maintains said power levels at predetermined values"*

485. Smith discloses to a POSITA "wherein said servo-control assembly maintains said power levels at predetermined values." For example, Smith explains that "[t]he optical intensities for all the fiber and wavelength-separated signals are demultiplexed and converted to analog or digital form and supplied to the controller, which then adjusts the mirror positions to adjust the transmitted power to conform to one or more ***predetermined criteria***." *See* Smith at 11:46-51 (emphasis added); *see also id.* at 9:59-10:13; *see also* Smith Prov. at 6:10-14, 11:4-23, FIG. 4.

486. Therefore, Smith discloses to a POSITA "wherein said servo-control assembly maintains said power levels at predetermined values."

(xi) *'905 Patent, [27] "The optical add-drop apparatus of claim 24, wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal"*

487. Smith discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal." For example, Smith discloses "a WDM add/drop multiplexer (WADM) in which the input ports IN, IN are associated respectively with the input (IN) port of the transmission fiber and ***the DROP port*** to the local node and the output ports OUT, OUT are associated respectively with the output (OUT) port of the transmission fiber and the ADD port from the local node." *See* Smith at 8:40-59; *see also id.* at 12:4-12, Figs. 8-13; *see also* Smith Prov. at 4:9-17, 7:6-18, Figs. 1-6.

488. Therefore, Smith discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal."

(xii) *'905 Patent, [28] "The optical add-drop apparatus of claim 24, wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal"*

489. Smith discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal." For example, Smith discloses "a WDM add/drop multiplexer (WADM) in which the input ports IN, IN are associated

respectively with the input (IN) port of the transmission fiber and ***the DROP port*** to the local node and the output ports OUT, OUT are associated respectively with the output (OUT) port of the transmission fiber and the ADD port from the local node." *See* Smith at 8:40-59; *see also id.* at 12:4-12, 18:42-53, Figs. 8-13; *see also* Smith Prov. at 4:9-17, 7:6-18, Figs. 1-6.

490. Therefore, Smith discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal."

(xiii) *'905 Patent, [29] "The optical add-drop apparatus of claim 23 further comprising alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device"*

491. Smith discloses to a POSITA "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device." For example, Smith provides for "[v]arious mirrors 192,194,196, 198,200 [that] are included to condense the overall size of the system with little significant influence on the overall operation" and "[a] lens system 202 [that] focuses the beams onto a MEMS mirror array 204, placing the gaussian waists of the beams at the mirror surfaces." *See* Smith at 12:39-50; *see also id.* at Abstract, 3:66-4:12, 4:40-42, 4:56-60, 5:27-32, 7:32-44, 8:19-20, 14:49-65, 15:35-54, 16:9-51, 19:51-55, Figs. 5, 6, 14, 16; *see also* Smith Prov. at 3:16-24, 6:3-7, 7:29-8:2, 8:5-11, 9:4-23, 10:1-20, Figs. 1-3, 6, 7.

492. Therefore, Smith discloses to a POSITA "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device."

> **(xiv)** *'905 Patent, [31] "The optical add-drop apparatus of claim 23, wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal"*

493. Smith discloses to a POSITA "wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal." For example, Smith explains that "[e]ach output mirror 80 is also tiltable in correspondence to the tilt angle of the input mirror 76 to which it is coupled through the folding mirror 86 so that the same optics 68, 70, 74 used to focus and demultiplex the beams from the input fibers 52, 54 are also used ***to multiplex the wavelength separated output beams onto the two output fibers 56, 58***. That is, the diffraction grating 70 acts as both a demultiplexer on the input and ***a multiplexer on the output***." *See* Smith at 5:8-15, Fig. 5; *see also id.* at 5:22-43, 8:53-59, 12:29-42, Figs. 5, 6, 8, 9; *see also* Smith Prov. at 8:5-13, Figs. 1, 2.

494. Therefore, Smith discloses to a POSITA "wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal."

> **(xv)** *'905 Patent, [32] "The optical add-drop apparatus of claim 23, wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels"*

495. Under Capella's apparent interpretation, Smith discloses to a POSITA "wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels." For example, Smith discloses that "[f]or an add/drop multiplexer, the four fibers 162, 164, 166, 168 correspond respectively, for example, to IN, OUT, ***ADD***, and ***DROP***" and that "[a]n NxN cross

connect can be implemented by ***increasing the numbers of fibers and planar waveguides*** although it is appreciated that this enlargement additionally constrains the design of the rest of the system." *See* Smith at 12:4-12; *see also id.* at Figs. 9-13; *see also* Smith Prov. at 2:9-13, 4:9-17, 7:6-18, Figs. 1-6. Smith further explains that "the outputs of the four planar waveguides 172-178 are placed at or near the focal point of a collimating lens system 188." *See id.* at 12:29-42. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

496. Therefore, under Capella's apparent interpretation, Smith discloses to a POSITA "wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels."

(xvi) *'905 Patent, [33] "The optical add-drop apparatus of claim 23 further comprising a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements"*

497. Smith discloses to a POSITA "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements." For example, Smith explains that "[a] lens system 202 ***focuses the beams onto a MEMS mirror array 204***, placing the gaussian waists of the beams at the mirror surfaces." *See* Smith at 12:43-50; *see also id.* at Figs. 9, 11, 13; *see also* Smith Prov. at 7:29-8:2, Figs. 1, 8, 9.

498. Therefore, Smith discloses to a POSITA "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements."

(xvii) *'905 Patent, [34] "The optical add-drop apparatus of claim 23, wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms"*

499. Smith discloses to a POSITA "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms." For example, Smith explains that "[t]he collimated beams, which propagate substantially within a common plane, are incident upon ***a diffraction grating 190 having grating lines extending parallel to the plane of the illustration*** so that the wavelength components are angularly separated perpendicularly to the plane of the illustration." *See* Smith at 12:29-39; *see also id.* at Figs. 5, 6, 9; *see also* Smith Prov. at 7:25-29, FIG. 6.

500. Therefore, Smith discloses to a POSITA "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."

(xviii) *'905 Patent, [35] "The optical add-drop apparatus of claim 23, wherein said beam-deflecting elements comprise micromachined mirrors"*

501. Smith discloses to a POSITA "wherein said beam-deflecting elements comprise micromachined mirrors." For example, Smith explains:

> ***The MEMS array 204 is preferably formed as a two-dimensional array of dual-axis tiltable mirrors***, one mirror 260 of which is illustrated in plain view in FIG. 14 and in cross-sectional view in FIG. 15 taken along view line 15-15 of FIG. 14. The cell is one of many such cells arranged typically in a two-dimensional array in a bonded structure including multiple levels of silicon and oxide layers in what is referred to as a multi-level silicon-over-insulator (SOI) structure. The cell includes a gimbal structure of an outer frame 262 twistably supported in a support structure 264 of the MEMS array through a first pair of torsion beams 266 extending along and twisting about a minor axis. The cell further includes a

> mirror plate 268 having a reflective surface 270 twistably supported on the outer frame 262 through a second pair of torsion beams 272 arranged along a major axis perpendicular to the minor axis and twisting thereabout. ***In one MEMS fabrication technique, the illustrated structure is integrally formed in an epitaxial (epi) layer of crystalline silicon.*** The process has been disclosed in U.S. Provisional Application, Ser. No. 60/260,749, filed Jan. 10, 2001, incorporated herein by reference in its entirety. However, other fabrication processes resulting in somewhat different structures may be used without affecting the present invention.

Smith at 14:49-15:5 (emphasis added); *see also id.* at 3:66-4:12, 7:11-23, 12:39-50, Figs. 5, 6, 14, 16; *see also* Smith Prov. at 10:21-29.

502. A POSITA would understand that a MEMs (*i.e.*, microelectromechanical system) array of mirrors would disclose micromachined mirrors. Therefore, Smith discloses to a POSITA "wherein said beam-deflecting elements comprise micromachined mirrors."

(xix) *'905 Patent, [37] "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator"*

503. Smith discloses to a POSITA "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator." For example, Smith explains that "[a] 2x2 optical cross connect (OXC) 142 links two ***input fibers*** 144, 146 connected to input ports IN, IN to two ***output fibers*** 148, 150 connected to output ports OUT, OUT. . . . This architecture applies as well to a WDM add/drop multiplexer (WADM) in which the input ports IN, IN are associated respectively with the input (IN) port of the transmission fiber and the DROP port to the local node and the output ports OUT, OUT are associated respectively with the output (OUT) port of the transmission fiber and the ADD port from the local node." *See* Smith at 8:40-59; *see also id.* at 3:66-4:24, 12:4-12, 12:29-42, Figs. 5, 8-13; *see also Smith Prov.* at 2:9-13, 3:16-4:3, 4:9-17, 7:6-8:4, Figs. 1-6. In fact, Smith does not use circulators anywhere in its disclosure.

504. Therefore, Smith discloses to a POSITA "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator."

(xx) *'905 Patent, [39] "The optical add-drop apparatus of claim 23, wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array"*

505. Smith discloses to a POSITA "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array." For example, Smith explains that "[t]wo fiber waveguides 52, 54 and two output fiber waveguides 56, 58 are ***aligned linearly parallel to each other*** to couple into two free-space input beams 60, 62 and two free-space output beams 64, 66." *See* Smith at 4:16-24 (emphasis added); *see also id.* at Figs. 5, 6; *see also* Smith Prov. at Figs. 6, 7.

506. Therefore, Smith discloses to a POSITA "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array."

(xxi) *'905 Patent, [44] "The optical add-drop apparatus of claim 23, further comprising a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels"*

507. Smith discloses to a POSITA "a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels." For example, Smith discloses "[a] portion of the switched output signal [that] may be diverted to an optical power monitor to enable feedback control of the power adjustment" and that "[d]ynamic power equalization advantageously involves monitoring of power levels for the individual WDM wavelength channels on each fiber in the system [to] provide[] feedback for the power equalization mechanism." *See* Smith at 7:24-31; *see also* Smith at 13:20-14:15, Fig.

12; *see also* Smith Prov. at 10:30-11:26, Figs. 10, 11. Smith further explains that "the optical power monitor 156 preferably measures the power on each of the WDM channels, and the controller 158 accordingly adjusts the power transmission for that wavelength channel through the cross connect 142." *See* Smith at 9:29-33; *see also id.* at 9:59-10:13; *see also* Smith Prov. at 10:30-11:26, Figs. 10, 11. Specifically, Smith explains that "[e]ach time an input optical signal is routed to a new output fiber, the microprocessor reads the optimum position settings for both axes of both the input and output mirrors associated with this routing combination and sets the mirror positions accordingly." *See* Smith at 18:42-53; *see also* Smith Prov. at 10:30-11:26, Figs. 10, 11. Figure 8, reproduced below, "is a block diagram of an optical switching system including an optical power monitor and feedback control." *See* Smith at 8:3-4, Fig. 8; *see also* Smith Prov. at 10:30-11:26, Figs. 10, 11.

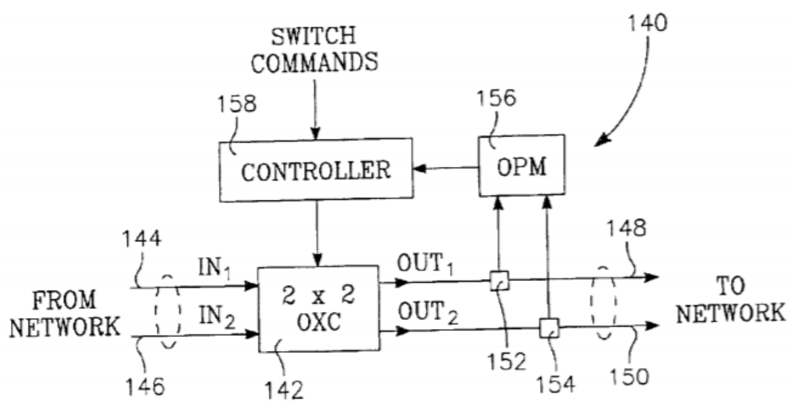


FIG. 8

508. Therefore, Smith discloses to a POSITA "a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels."

(xxii) *'905 Patent, [45] "The optical add-drop apparatus of claim 44, wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port"*

509. Smith discloses to a POSITA "wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port." For example, Smith explains that "the optical power monitor 156 preferably ***measures the power*** on each of the WDM channels, and the controller 158 accordingly ***adjusts the power*** transmission for that wavelength channel through the cross connect 142." *See* Smith at 9:20-33; *see also id.* at 11:13-35, 18:42-53, Figs. 11-13; *see also* Smith Prov. at 7:3-4, 11:2-11, Figs. 4, 11. Smith further explains that "[t]he optical taps 152, 154 and the optical power monitor 156 may be realized in several ways, all accomplishing the benefits of the invention." *See* Smith at 9:20-33; *see also id.* at 11:13-35, 18:42-53, Figs. 11-13; *see also* Smith Prov. at 7:3-4, 11:2-11, Figs. 4, 11.

510. Smith further explains that "[t]he optical intensities for all the fiber and wavelength-separated signals are demultiplexed and converted to analog or digital form and supplied to the controller, which then adjusts the mirror positions to adjust the transmitted power to conform to one or more ***predetermined criteria***." *See* Smith at 11:46-51 (emphasis added); *see also id.* at 9:59-10:13; *see also* Smith Prov. at 6:10-14, 11:4-23, FIG. 4.

511. Therefore, Smith discloses to a POSITA "wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port."

(xxiii) *'905 Patent, [46] "The optical add-drop apparatus of claim 23, wherein the beam-deflecting elements are micromirrors"*

512. Smith discloses to a POSITA "wherein the beam-deflecting elements are micromirrors." For example, Smith explains:

> ***The MEMS array 204 is preferably formed as a two-dimensional array of dual-axis tiltable mirrors***, one mirror 260 of which is illustrated in plain view in FIG. 14 and in cross-sectional view in FIG. 15 taken along view line 15-15 of FIG. 14. The cell is one of many such cells arranged typically in a two-dimensional array in a bonded structure including multiple levels of silicon and oxide layers in what is referred to as a multi-level silicon-over-insulator (SOI) structure. The cell includes a gimbal structure of an outer frame 262 twistably supported in a support structure 264 of the MEMS array through a first pair of torsion beams 266 extending along and twisting about a minor axis. The cell further includes a mirror plate 268 having a reflective surface 270 twistably supported on the outer frame 262 through a second pair of torsion beams 272 arranged along a major axis perpendicular to the minor axis and twisting thereabout. ***In one MEMS fabrication technique, the illustrated structure is integrally formed in an epitaxial (epi) layer of crystalline silicon.*** The process has been disclosed in U.S. Provisional Application, Ser. No. 60/260,749, filed Jan. 10, 2001, incorporated herein by reference in its entirety. However, other fabrication processes resulting in somewhat different structures may be used without affecting the present invention.

Smith at 14:49-15:5 (emphasis added); *see also id.* at 3:66-4:12, 7:11-23, 12:39-50, Figs. 5, 6, 14, 16; *see also* Smith Prov. at 10:21-29.

513. A POSITA would understand that a MEMs (*i.e.*, microelectromechanical system) array of mirrors would disclose micromirrors. Therefore, Smith discloses to a POSITA "wherein the beam-deflecting elements are micromirrors."

(xxiv) *'905 Patent, [47-pre] "An optical add-drop apparatus, comprising"*

514. I previously analyzed Smith in view of the following limitations:

- "[a]n optical add-drop apparatus," discussed above in Section IX.1.b.ii (Paragraphs 464-466).

I incorporate that analysis by reference.

(xxv) *'905 Patent, [47-a] "a fiber collimator serving as an input port for an input multi-wavelength optical signal having multiple spectral channels"*

515. I previously analyzed Smith in view of the following limitations:

- "fiber collimators serving as an input port . . . ," discussed above in Section IX.1.b.ii (Paragraphs 464-466); and
- "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels[,]" discussed above in Section IX.1.b.iii (Paragraphs 467-468).

I incorporate that analysis by reference.

(xxvi) *'905 Patent, [47-b] "an output port for an output multi-wavelength optical signal"*

516. I previously analyzed Smith in view of the following limitations:

- "an output port . . . ," discussed above in Section IX.1.b.ii (Paragraphs 464-466); and
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.b.v (Paragraphs 472-473).

I incorporate that analysis by reference.

(xxvii) *'905 Patent, [47-c] "one or more fiber collimators serving as one or more drop ports for selected spectral channels dropped from said multi-wavelength optical signal"*

517. I previously analyzed Smith in view of the following limitations:

- "fiber collimators serving as . . . one or more other ports . . . ," discussed above in Section IX.1.b.ii (Paragraphs 464-466); and
- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.b.x (Paragraphs 485-486).

I incorporate that analysis by reference.

(xxviii) *'905 Patent, [47-d] "a wavelength-selective device for spatially separating said multiple spectral channels"*

518. I previously analyzed Smith in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.b.v (Paragraphs 472-473).

I incorporate that analysis by reference.

(xxix) *'905 Patent, [47-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports and to control the power of the spectral channel reflected to said output port of the fiber collimator serving as said selected port, whereby a subset of said spectral channels is directed to said fiber collimator serving as said drop ports"*

519. I previously analyzed Smith in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.b.vi (Paragraphs 474-475); and
- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.b.x (Paragraphs 485-486).

I incorporate that analysis by reference.

(xxx) *'905 Patent, [48] "The optical add-drop apparatus of claim 47, wherein none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"*

520. I previously analyzed Smith in view of the following limitations:

- "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]" discussed above in Section IX.1.b.xix (Paragraphs 503-504).

I incorporate that analysis by reference.

(xxxi) *'905 Patent, [49] "An optical add-drop apparatus, comprising"*

521. I previously analyzed Smith in view of the following limitations:

- "[a]n optical add-drop apparatus[,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466).

I incorporate that analysis by reference.

(xxxii) *'905 Patent, [49-a] "a fiber collimator serving as an input port for an input multi-wavelength optical signal having multiple spectral channels"*

522. I previously analyzed Smith in view of the following limitations:

- "fiber collimators serving as an input port . . . [,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466); and
- "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels[,]" discussed above in Section IX.1.b.iii (Paragraphs 467-468).

I incorporate that analysis by reference.

(xxxiii) *'905 Patent, [49-b] "an output port for an output multi-wavelength optical signal"*

523. I previously analyzed Smith in view of the following limitations:

- "an output port . . . ," discussed above in Section IX.1.b.ii (Paragraphs 464-466); and

- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.b.v (Paragraphs 472-473).

I incorporate that analysis by reference.

(xxxiv) *'905 Patent, [49-c] "one or more fiber collimators serving as one or more add ports for selected spectral channels to be added to said output multi-wavelength optical signal"*

524. I previously analyzed Smith in view of the following limitations:

- "fiber collimators serving as . . . one or more other ports . . . ," discussed above in Section IX.1.b.ii (Paragraphs 464-466); and
- "direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.b.xii (Paragraphs 489-490).

I incorporate that analysis by reference.

(xxxv) *'905 Patent, [49-d] "a wavelength-selective device for reflecting said multiple and said selected spectral channels"*

525. I previously analyzed Smith in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.b.vi (Paragraphs 474-475).

I incorporate that analysis by reference.

526. Furthermore, with reference to Figure 9, reproduced below, Smith explains that "[t]he collimated beams, which propagate substantially within a common plane, are incident upon a diffraction grating 190 having grating lines extending parallel to the plane of the illustration so that the wavelength components are angularly separated perpendicularly to the plane of the illustration" and that "[t]he beams may overlap when they strike the grating 190, which wavelength separates the four beams into corresponding Sets of wavelength-separated

beams, only one set of which is illustrated." *See* Smith at 12:29-42; *see also id.* at 4:16-29, 5:38-43, Figs. 5, 6, 9, 11, 13; *see also* Smith Prov. at 3:18-22, 4:18-21, 7:25-8:1, Figs. 1, 6, 8-10.

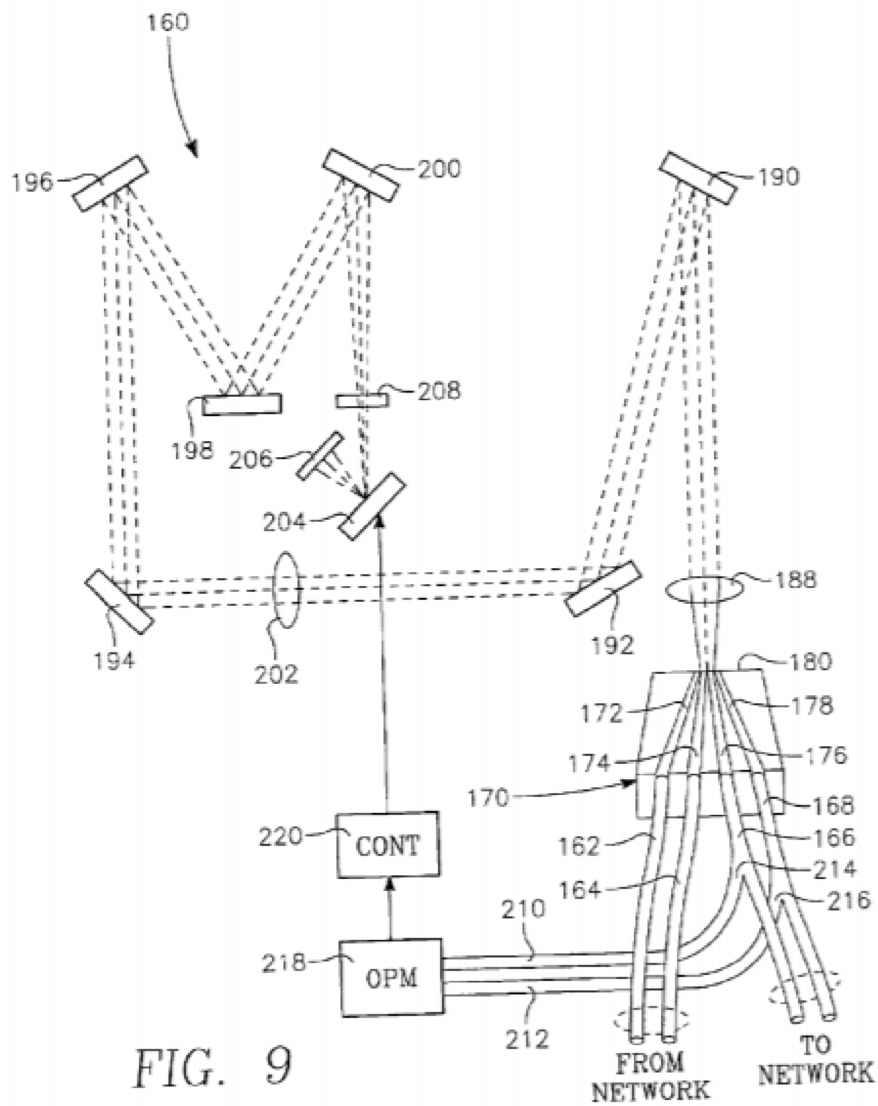


FIG. 9

527. A POSITA would understand that, as shown in Figure 9, the diffraction grating reflects the spectral channels. Therefore, Smith discloses to a POSITA "a wavelength-selective device for reflecting said multiple and said selected spectral channels."

(xxxvi) *'905 Patent, [49-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports and to control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port, whereby said spectral channels from said fiber collimators serving as said add ports are selectively provided to said output port"*

528. I previously analyzed Smith in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480); and
- "direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.b.xii (Paragraphs 489-490).

I incorporate that analysis by reference.

(xxxvii) *'905 Patent, [50] "The optical add-drop apparatus of claim 49, wherein none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"*

529. I previously analyzed Smith in view of the following limitations:

- "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]" discussed above in Section IX.1.b.xix (Paragraphs 503-504).

I incorporate that analysis by reference.

(xxxviii) *'905 Patent, [51-pre] "A method of performing dynamic add and drop in a WDM optical network, comprising"*

530. I previously analyzed Smith in view of the following limitations:

- "[a]n optical add-drop apparatus[,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466);
- "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.b.xi (Paragraphs 487-488); and
- "the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.b.xii (Paragraphs 489-490).

I incorporate that analysis by reference.

531. To the extent the language in the preamble is considered limiting, a POSITA would understand that the disclosed WDM add/drop multiplexer in Smith would also disclose "[a] method of performing dynamic add and drop in a WDM optical network." Therefore, Smith discloses to a POSITA "[a] method of performing dynamic add and drop in a WDM optical network."

(xxxix) *'905 Patent, [51-a] "separating an input multi-wavelength optical signal into spectral channels"*

532. I previously analyzed Smith in view of the following similar limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.b.vi (Paragraphs 474-475).

I incorporate that analysis by reference.

(xl) *'905 Patent, [51-b] "imaging each of said spectral channels onto a corresponding beam-deflecting element"*

533. I previously analyzed Smith in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channel[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480); and
- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480).

I incorporate that analysis by reference.

(xli) *'905 Patent, [51-c] "controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal"*

534. I previously analyzed Smith in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.b.viii (Paragraphs 481-482);
- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power

levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.b.ix (Paragraphs 483-484); and

- "said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal[,]" discussed above in Section IX.1.b.xiv (Paragraphs 493-494).

I incorporate that analysis by reference.

535. A POSITA would understand that the disclosed individually and continuously controllable beam-deflecting elements of Smith are dynamically controlled. *See Smith* at Abstract, 3:66-4:12, 4:40-42, 4:56-60, 5:8-15, 5:22-43, 7:24-44, 8:2-4, 8:19-20, 8:53-59, 9:20-33, 11:13-35, 12:29-50, 13:20-14:15, 14:49-65, 15:35-54, 16:9-51, 18:42-53, 19:51-55, FIGS. 5, 6, 8, 9, 11-14, 16; *see also* Smith Prov. at 3:16-24, 6:3-7, 6:10-14, 7:3-4, 7:29-8:2, 8:5-13, 9:4-23, 10:1-20, 11:2-23, FIGS. 1-4, 6, 7, 11. Therefore, Smith discloses to a POSITA "controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal."

(xlii) *'905 Patent, [51-d] "receiving the output multi-wavelength optical signal at an output port that transmits the output multi-wavelength optical signal to an optical fiber; and wherein"*

536. I previously analyzed Smith in view of the following limitations:

- "an output port[,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466);
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.b.v (Paragraphs 472-473); and

- "each of said elements . . . reflect[ing] its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480).

I incorporate that analysis by reference.

537. Smith specifically discloses transmitting the output signal "to an output fiber." For example, Smith explains that "[a] 2x2 optical cross connect (OXC) 142 links two input fibers 144, 146 connected to input ports IN, IN to ***two output fibers 148, 150 connected to output ports OUT, OUT***." *See* Smith. at 8:40-46 (emphasis added); *see also id.* at Abstract, 3:66-4:12, 4:40-42, 4:56-60, 5:27-32, 7:32-44, 8:19-20, 8:47-59, 12:4-12, 12:39-50, 14:49-65, 15:35-54, 16:9-51, 19:51-55, FIGS. 5, 6, 8-14, 16; *see also* Smith Prov. at 2:9-13, 3:16-24, 4:9-17, 6:3-7, 7:6-18, 7:29-8:2, 8:5-11, 9:4-23, 10:1-20, FIGS. 1-7. Therefore, Smith discloses to a POSITA "receiving the output multi-wavelength optical signal at an output port that transmits the output multi-wavelength optical signal to an optical fiber."

(xliii) *'905 Patent, [51-e] "said selected ones of said spectral channels comprises a subset of said spectral channels, such that other non-selected ones of said spectral channels are dropped from said output multi-wavelength optical signal; and"*

538. I previously analyzed Smith in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480); and
- "direct[ing] selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.b.xi (Paragraphs 487-488).

I incorporate that analysis by reference.

(xliv) *'905 Patent, [51-f] "said controlling comprises reflecting said non-selected ones of said spectral channels to one or more fiber collimator serving as drop ports"*

539. I previously analyzed Smith in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.b.viii (Paragraphs 481-482); and
- "direct[ing] selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.b.xi (Paragraphs 487-488).

I incorporate that analysis by reference.

(xlv) *'905 Patent, [52] "The method of claim 51 further comprising imaging other spectral channels onto other corresponding beam-deflecting elements, and controlling dynamically and continuously said other beam-deflecting elements so as to combine said other spectral channels with said selected ones of said spectral channels into said output multi-wavelength optical signal"*

540. I previously analyzed Smith in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480);

- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.b.viii (Paragraphs 481-482);
- "direct[ing] selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.b.xii (Paragraphs 489-490); and
- "controlling dynamically . . . beam-deflecting elements[,]" discussed above in Section IX.1.b.xli (Paragraphs 534-535).

I incorporate that analysis by reference.

(xlvi) *'905 Patent, [53] "The method of claim 51, wherein said imaging comprises focusing said spectral channels onto said beam-deflecting elements"*

541. I previously analyzed Smith in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480); and
- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.b.xvi (Paragraphs 497-498).

I incorporate that analysis by reference.

(xlvii) *'905 Patent, [54] "The method of claim 51 further comprising monitoring a power level in one or more of said selected ones of said spectral channels, and controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring"*

542. I previously analyzed Smith in view of the following limitations:

- "a spectral monitor for monitoring said power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said

beam-deflecting elements[,]" discussed above in Section IX.1.b.ix (Paragraphs 483-484).

I incorporate that analysis by reference.

(xlviii) *'906 Patent, [68-pre] "A wavelength-separating-routing apparatus, comprising"*

543. To the extent the language in the preamble is considered limiting, Smith discloses to a POSITA "[a] wavelength-separating-routing apparatus." For example, Smith discloses "a WDM add/drop multiplexer (WADM) in which the input ports IN, IN are associated respectively with the input (IN) port of the transmission fiber and the DROP port to the local node and the output ports OUT, OUT are associated respectively with the output (OUT) port of the transmission fiber and the ADD port from the local node." *See* Smith at 8:53-59; *see also id.* at 12:4-12, Figs. 8-13; *see also* Smith Prov. at 2:9-13, 4:9-17, 7:6-18, Figs. 1-6. Therefore, Smith discloses to a POSITA "[a] wavelength-separating-routing apparatus."

(xlix) *'906 Patent, [68-a] "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports"*

544. I previously analyzed Smith in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466).

I incorporate that analysis by reference.

545. Furthermore, Smith explains that "the invention is directly applicable to a larger number of input and output fibers." *See* Smith at 8:45-46. A POSITA would understand that a system with a larger number of input and output fibers would also have a larger number of fiber collimators, which would be formed in an array. Therefore, under Capella's apparent

interpretation, Smith discloses to a POSITA "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports."

(l) *'906 Patent, [68-b] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

546. I previously analyzed Smith in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.b.vi (Paragraphs 474-475).

I incorporate that analysis by reference.

(li) *'906 Patent, [68-c] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

547. I previously analyzed Smith in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.b.xvi (Paragraphs 497-498).

I incorporate that analysis by reference.

(lii) *'906 Patent, [68-d] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports"*

548. I previously analyzed Smith in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control

the power of the spectral channel reflected to said output port or the fiber collimator selected port [,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480).

I incorporate that analysis by reference.

549. Smith discloses to a POSITA "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports." For example, Smith provides "[a] multi-wavelength or white-light optical switch including ***an array of mirrors tiltable about two axes***, both to control the switching and to provide variable power transmission through the switch, both for optimization and for power equalization between wavelength channels in a multi-wavelength signal." *See* Smith at Abstract (emphasis added); *see also id.* at 3:66-4:12, 4:40-42, 4:56-60, 5:27-32, 7:32-44, 8:19-20, 12:39-50, 14:49-65, 15:35-54, 16:9-51, 19:51-55, Figs. 5, 6, 14, 16; *see also* Smith Prov. at 3:16-24, 6:3-7, 7:29-8:2, 8:5-11, 9:4-23, 10:1-20, Figs. 1-3, 6, 7.

550. Therefore, Smith discloses to a POSITA "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports."

(liii) *'906 Patent, [69] "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports"*

551. I previously analyzed Smith in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.b.ix (Paragraphs 483-484); and
- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.b.x (Paragraphs 485-486).

I incorporate that analysis by reference.

552. A POSITA would understand that to control the beam-deflecting elements, the servo-control assembly would be in communication with the beam-deflecting elements. *See* Smith at 7:24-31, 8:2-4, 9:29-33, 9:59-10:13, 11:46-51, 13:20-14:15, 18:42-53, Figs. 8, 12; *see also* Smith Prov. at 6:10-14, 11:4-23, Fig. 4. Therefore, Smith discloses to a POSITA "a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports." Further, to the extent Smith does not teach "maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports," this limitation would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(liv)** *'906 Patent, [70] "The wavelength-separating-routing apparatus of claim 69 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

553. I previously analyzed Smith in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.b.ix (Paragraphs 483-484).

I incorporate that analysis by reference.

> **(lv)** *'906 Patent, [71] "The wavelength-separating-routing apparatus of claim 70 wherein said servo-control assembly maintains said power levels at a predetermined value."*

554. I previously analyzed Smith in view of the following limitations:

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]" discussed above in Section IX.1.b.x (Paragraphs 485-486).

I incorporate that analysis by reference.

> **(lvi)** *'906 Patent, [72] "The wavelength-separating-routing apparatus of claim 68 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."*

555. I previously analyzed Smith in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.b.xiii (Paragraphs 491-492); and

- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.b.xlvii (Paragraph 542).

I incorporate that analysis by reference.

556. A POSITA would understand that to adjust alignment of the input and output multi-wavelength optical signals and to control an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements, the collimator-alignment mirrors would be in optical communication with the wavelength-separator, the fiber collimator input port, and the output ports. *See* Smith at Abstract, 3:66-4:12, 4:40-42, 4:56-60, 5:27-32, 7:32-44, 8:19-20, 12:39-50, 14:49-65, 15:35-54, 16:9-51, 19:51-55, Figs. 5, 6, 14, 16; *see also* Smith Prov. at 3:16-24, 6:3-7, 7:29-8:2, 8:5-11, 9:4-23, 10:1-20, Figs. 1-3, 6, 7.Therefore, Smith discloses to a POSITA "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."

(lvii) *'906 Patent, [79] "The wavelength-separating-routing apparatus of claim 68 wherein each channel micromirror is a silicon micromachined mirror."*

557. Smith discloses to a POSITA "wherein each channel micromirror is a silicon micromachined mirror." For example, Smith explains:

> ***The MEMS array 204 is preferably formed as a two-dimensional array of dual-axis tiltable mirrors***, one mirror 260 of which is illustrated in plain view in FIG. 14 and in cross-sectional view in FIG. 15 taken along view line 15-15 of FIG. 14. The cell is one of many such cells arranged typically in a two-dimensional array in a bonded structure including multiple levels of silicon and oxide layers in what is referred to as a multi-level silicon-over-insulator (SOI) structure. The cell includes a gimbal structure of an outer frame 262 twistably supported in a support structure 264 of the MEMS array through a first pair of torsion beams 266 extending along and twisting about a minor axis. The cell further includes a

> mirror plate 268 having a reflective surface 270 twistably supported on the outer frame 262 through a second pair of torsion beams 272 arranged along a major axis perpendicular to the minor axis and twisting thereabout. ***In one MEMS fabrication technique, the illustrated structure is integrally formed in an epitaxial (epi) layer of crystalline silicon.*** The process has been disclosed in U.S. Provisional Application, Ser. No. 60/260,749, filed Jan. 10, 2001, incorporated herein by reference in its entirety. However, other fabrication processes resulting in somewhat different structures may be used without affecting the present invention.

Smith at 14:49-15:5 (emphasis added); *see also id.* at 3:66-4:12, 7:11-23, 12:39-50, Figs. 5, 6, 14, 16; *see also* Smith Prov. at 10:21-29.

558. A POSITA would understand that a MEMs (*i.e.*, microelectromechanical system) array of mirrors would disclose micromachined mirrors. Therefore, Smith discloses to a POSITA "wherein each channel micromirror is a silicon micromachined mirror."

(lviii) *'906 Patent, [80] "The wavelength-separating-routing apparatus of claim 68 wherein said fiber collimator input and output ports are arranged in a one-dimensional array."*

559. I previously analyzed Smith in view of the following limitations:

- "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array[,]"discussed above in Section IX.1.b.xx (Paragraphs 505-506).

I incorporate that analysis by reference.

(lix) *'906 Patent, [81] "The wavelength-separating-routing apparatus of claim 68 wherein said beam-focuser comprises a focusing lens having first and second focal points."*

560. To the extent Smith does not teach "wherein said beam-focuser comprises a focusing lens having first and second focal points[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(lx)** *'906 Patent, [82] "The wavelength-separating-routing apparatus of claim 81 wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens."*

561. To the extent Smith does not teach "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(lxi)** *'906 Patent, [83] "The wavelength-separating-routing apparatus of claim 68 wherein said beam-focuser comprises an assembly of lenses."*

562. Smith discloses to a POSITA "wherein said beam-focuser comprises an assembly of lenses." For example, Smith explains that "[a] lens system 202 ***focuses*** the beams onto a MEMS mirror array 204, placing the gaussian waists of the beams at the mirror surfaces. The MEMS mirror array 204 of the illustrated system includes both input mirrors and output mirrors for each channel through the switch, that is, two input mirrors and two output mirrors for each wavelength for the illustrated four-fiber system which includes two input fibers and two output fibers." *See* Smith at 12:43-50; *see also id.* at Figs. 9, 11, 13; *see also* Smith Prov. at 7:29-8:2, Figs. 1, 8, 9. A POSITA would understand that the lens system would be a compound lens system and, therefore, include assembly of lenses.

563. Therefore, Smith discloses to a POSITA "wherein said beam-focuser comprises an assembly of lenses."

> **(lxii)** *'906 Patent, [84] "The wavelength-separating-routing apparatus of claim 68 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing gratings."*

564. I previously analyzed Smith in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.b.xvii (Paragraphs 499-500).

I incorporate that analysis by reference.

(lxiii) *'906 Patent, [85] "The wavelength-separating-routing apparatus of claim 68 further comprising a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors."*

565. To the extent Smith does not teach "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxiv) *'906 Patent, [86] "The wavelength-separating-routing apparatus of claim 68 wherein each fiber collimator output port carries a single one of said spectral channels."*

566. Smith discloses to a POSITA "wherein each fiber collimator output port carries a single one of said spectral channels." For example, with reference to Figure 9, reproduced below, Smith explains that "the outputs of the four planar waveguides 172-178 are placed at or near the focal point of a collimating lens system 188. The collimated beams, which propagate substantially within a common plane, are incident upon ***a diffraction grating 190*** having grating lines extending parallel to the plane of the illustration so that the wavelength components are angularly separated perpendicularly to the plane of the illustration. The beams may overlap when they strike the ***grating 190, which wavelength separates the four beams into corresponding sets of wavelength-separated beams,*** only one set of which is illustrated. Various mirrors 192,194,196, 198,200 are included to condense the overall size of the system

with little significant influence on the overall operation." *See* Smith at 12:29-42 (emphasis added), Fig. 9; *see also id.* at 4:16-29, 5:38-43, Figs. 5, 6, 11, 13; *see also* Smith Prov. at 3:18-22, 4:18-21, 7:25-8:1, FIGS. 1, 6, 8-10.

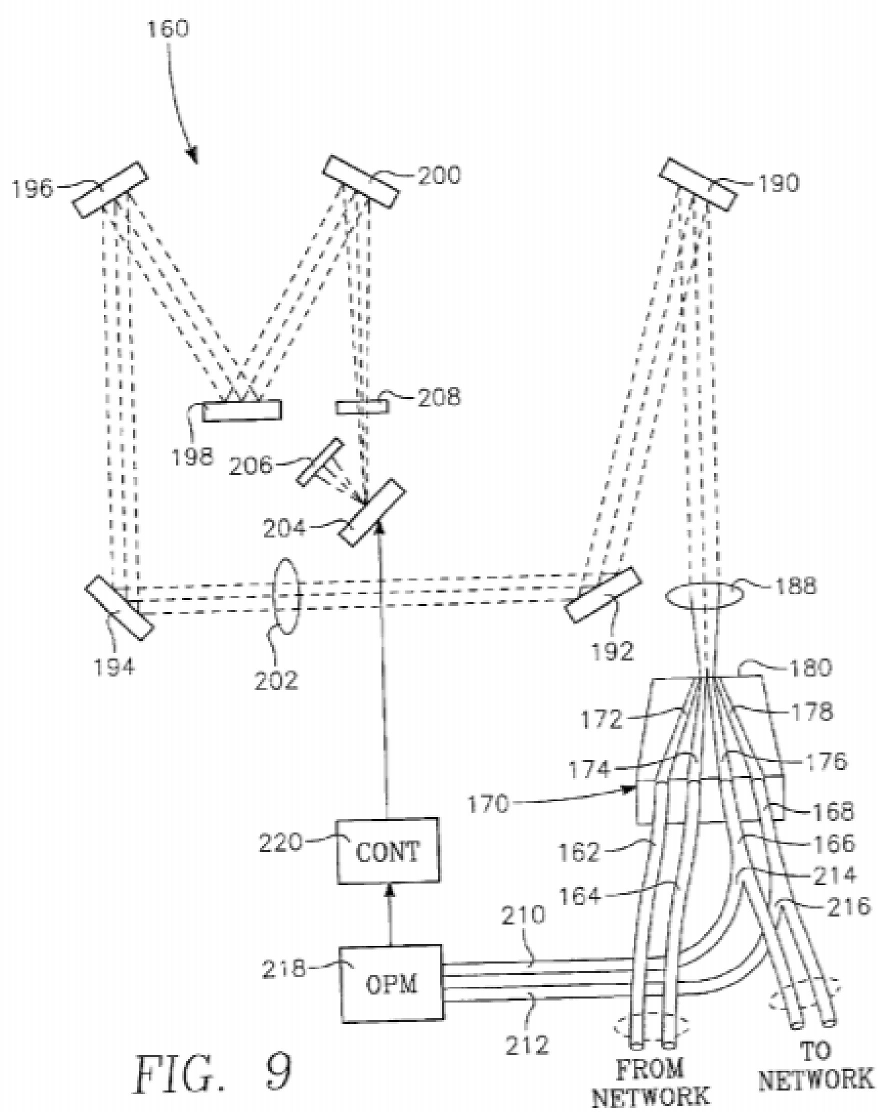


FIG. 9

567. A POSITA would understand that each individual wavelength could be sent to a corresponding output port, *e.g.*, if the wavelength was not multiplexed with any other wavelengths. Therefore, Smith discloses to a POSITA "wherein each fiber collimator output port carries a single one of said spectral channels."

> **(lxv)** *'906 Patent, [87] "The wavelength-separating-routing apparatus of claim 86 further comprising one or more optical sensors, optically coupled to said fiber collimator output ports."*

568. Smith discloses to a POSITA "one or more optical sensors, optically coupled to said fiber collimator output ports." For example, Smith describes "***an optical monitoring system*** [that] is incorporated by ***fusing two monitoring fibers 210, 212 to the output fibers 166, 168*** to form Y-couplers 214, 216 coupling about 10% of the optical output power to the monitoring fibers 212, 216." *See* Smith at 13:7-20 (emphasis added); *see also id.* at 9:7-46, 11:39-46, 14:16-32, Figs. 8, 11-13; *see also* Smith Prov. at 11:2-13, Fig. 4.

569. Therefore, Smith discloses to a POSITA "one or more optical sensors, optically coupled to said fiber collimator output ports."

> **(lxvi)** *'906 Patent, [88] "The wavelength-separating-routing apparatus of claim 68, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator."*

570. I previously analyzed Smith in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.b.xix (Paragraphs 503-504).

I incorporate that analysis by reference.

> **(lxvii)** *'906 Patent, [89-pre] "A servo-based optical apparatus comprising"*

571. I previously analyzed Smith in view of the following limitations:

- "An optical . . . apparatus[,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.b.viii (Paragraphs 481-482); and

- "wherein the control unit further comprises a servo-control assembly[,]" discussed above in Section IX.1.b.ix (Paragraphs 483-484).

I incorporate that analysis by reference.

(lxviii) *'906 Patent, [89-a] "multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports"*

572. I previously analyzed Smith in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466); and
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports [,]" discussed above in Section IX.1.b.xlix (Paragraphs 544-545).

I incorporate that analysis by reference.

(lxix) *"'906 Patent, [89-b] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

573. I previously analyzed Smith in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.b.vi (Paragraphs 474-475).

I incorporate that analysis by reference.

(lxx) *'906 Patent, [89-c] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

574. I previously analyzed Smith in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.b.xvi (Paragraphs 497-498).

I incorporate that analysis by reference.

> **(lxxi)** *'906 Patent, [89-d] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said fiber collimator output ports"*

575. I previously analyzed Smith in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.b.lii (Paragraphs 548-550).

I incorporate that analysis by reference.

> **(lxxii)** *'906 Patent, [89-e] "a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports."*

576. I previously analyzed Smith in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power

levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.b.ix (Paragraphs 483-484);

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.b.x (Paragraphs 485-486); and
- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.b.liii (Paragraphs 551-552).

I incorporate that analysis by reference.

(lxxiii) *'906 Patent, [90] "The servo-based optical apparatus of claim 89 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

577. I previously analyzed Smith in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.b.ix (Paragraphs 483-484); and
- "said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors[,]" discussed above in Section IX.1.b.liv (Paragraph 553).

I incorporate that analysis by reference.

(lxxiv) *'906 Patent, [91] "The servo-based optical apparatus of claim 90 wherein said servo-control assembly maintains said power levels at a predetermined value"*

578. I previously analyzed Smith in view of the following limitations:

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]" discussed above in Section IX.1.b.x (Paragraphs 485-486); and
- "wherein said servo-control assembly maintains said power levels at a predetermined value[,]" discussed above in Section IX.1.b.lv (Paragraph 554).

I incorporate that analysis by reference.

(lxxv) *'906 Patent, [92] "The servo-based optical apparatus of claim 89 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."*

579. I previously analyzed Smith in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.b.xiii (Paragraphs 491-492);
- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.b.xlvii (Paragraph 542); and
- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port

and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.b.lvi (Paragraphs 555-556).

I incorporate that analysis by reference.

(lxxvi) *'906 Patent, [96] "The servo-based optical apparatus of claim 89 wherein each channel micromirror is a silicon micromachined mirror."*

580. I previously analyzed Smith in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.b.lvii (Paragraphs 557-558).

I incorporate that analysis by reference.

(lxxvii) *'906 Patent, [97] "The servo-based optical apparatus of claim 89 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

581. I previously analyzed Smith in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.b.xvii (Paragraphs 499-500).

I incorporate that analysis by reference.

(lxxviii) *'906 Patent, [98] "The servo-based optical apparatus of claim 89 wherein said beam-focuser comprises one or more lenses."*

582. I previously analyzed Smith in view of the following limitations:

- "wherein said beam-focuser comprises an assembly of lenses [,]"discussed above in Section IX.1.b.lxi (Paragraphs 562-563).

I incorporate that analysis by reference.

(lxxix) *'906 Patent, [99] "The servo-based optical apparatus of claim 89, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"*

583. I previously analyzed Smith in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.b.xix (Paragraphs 503-504).

I incorporate that analysis by reference.

(lxxx) *'906 Patent, [100-pre] "An optical apparatus comprising:"*

584. I previously analyzed Smith in view of the following limitations:

- "An optical . . . apparatus[,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466).

I incorporate that analysis by reference.

(lxxxi) *'906 Patent, [100-a] "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal"*

585. I previously analyzed Smith in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466); and
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports [,]" discussed above in Section IX.1.b.xlix (Paragraphs 544-545).

I incorporate that analysis by reference.

586. Furthermore, Smith explains that "the invention is directly applicable to a larger number of input and output fibers." *See* Smith at 8:45-46. A POSITA would understand that a system with a larger number of input and output fibers would also have a larger number of fiber

collimators, which would be formed in an array. Therefore, under Capella's apparent interpretation, Smith discloses to a POSITA "an array of fiber collimators."

(lxxxii) *'906 Patent, [100-b] "a plurality of output ports"*

587. I previously analyzed Smith in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466).

I incorporate that analysis by reference.

(lxxxiii) *'906 Patent, [100-c] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

588. I previously analyzed Smith in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.b.vi (Paragraphs 474-475).

I incorporate that analysis by reference.

(lxxxiv) *'906 Patent, [100-d] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

589. I previously analyzed Smith in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.b.xvi (Paragraphs 497-498).

I incorporate that analysis by reference.

(lxxxv) *'906 Patent, [100-e] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually and continuously controllable to reflect said spectral channels into selected ones of said output ports"*

590. I previously analyzed Smith in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.b.lii (Paragraphs 548-550).

I incorporate that analysis by reference.

(lxxxvi) *'906 Patent, [100-f] "a one-dimensional array of collimator-alignment mirrors, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports"*

591. I previously analyzed Smith in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.b.xiii (Paragraphs 491-492);
- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.b.xlvii (Paragraph 542); and

- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.b.lvi (Paragraphs 555-556).

I incorporate that analysis by reference.

592. Furthermore, with reference to Figure 16, reproduced below, Smith explains that "an input beam 290 is incident upon a first input mirror 260 and is reflected therefrom to the fold mirror 206" and therefrom "strikes either a first output mirror 260 or a second output mirror 260 to produce respective a first output beam 292 or a second output beam 294." *See* Smith at 16:9-35, Fig. 16; *see also id.* at19:51-55; *see also* Smith Prov. at 3:16-24, 6:3-7, 7:29-8:2, 8:5-11, 9:4-23, 10:1-20, Figs. 1-3, 6, 7. A POSITA would understand that Figure 16 depicts a two-dimensional array of mirrors and that a two-dimensional array includes a one-dimensional array.

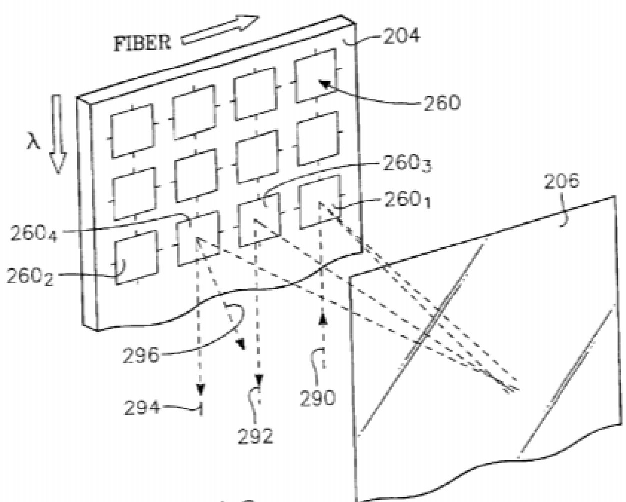


FIG. 16

593. Therefore, Smith discloses to a POSITA "a one-dimensional array of collimator-alignment mirrors."

(lxxxvii) *'906 Patent, [106] "The optical apparatus of claim 100, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"*

594. I previously analyzed Smith in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.b.xix (Paragraphs 503-504).

I incorporate that analysis by reference.

(lxxxviii) *'906 Patent, [115-pre] "An optical system comprising a wavelength-separating-routing apparatus, wherein said wavelength-separating-routing apparatus includes"*

595. I previously analyzed Smith in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]" discussed above in Section IX.1.b.xlviii (Paragraph 543).

I incorporate that analysis by reference.

596. To the extent the language in the preamble is considered limiting, a POSITA would understand that the disclosed WDM add/drop multiplexer in Smith would also disclose "a wavelength-separating-routing apparatus." Therefore, Smith discloses to a POSITA "a wavelength-separating-routing apparatus."

(lxxxix) *'906 Patent, [115-a] "an array of fiber collimators, providing and serving as an input port for a multi-wavelength optical signal"*

597. I previously analyzed Smith in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466);

- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports [,]" discussed above in Section IX.1.b.xlvix (Paragraph 539); and
- "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal[,]" discussed above in Section IX.1.b.lxxxi (Paragraphs 585-586).

I incorporate that analysis by reference.

(xc) *'906 Patent, [115-b] "a plurality of output ports including a pass-through port and one or more drop ports"*

598. I previously analyzed Smith in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466).

I incorporate that analysis by reference.

599. Smith discloses to a POSITA "a plurality of output ports including a pass-through port and one or more drop ports." Smith explains that "[a] 2x2 optical cross connect (OXC) 142 links two input fibers 144, 146 connected to input ports IN, IN to two output fibers 148, 150 connected to ***output ports OUT, OUT***," that "the invention is directly applicable to a larger number of input and output fibers," and that "[f]or an add/drop multiplexer, the four fibers 162, 164, 166, 168 correspond respectively, for example, to IN, OUT, ADD, and ***DROP***." *See* Smith at 8:40-46, 12:4-12; *see also id.* at 3:66-4:24, 8:47-59, 12:29-42, Figs. 5, 6, 8-13; *see also* Smith Prov. at 3:16-4:17, 7:6-8:4, Fig. 1-6.

600. Therefore, Smith discloses to a POSITA "a plurality of output ports including a pass-through port and one or more drop ports."

(xci) *'906 Patent, [115-c] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

601. I previously analyzed Smith in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.b.vi (Paragraphs 474-475).

I incorporate that analysis by reference.

(xcii) *'906 Patent, [115-d] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

602. I previously analyzed Smith in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.b.xvi (Paragraphs 497-498).

I incorporate that analysis by reference.

(xciii) *'906 Patent, [115-e] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels."*

603. I previously analyzed Smith in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.b.lii (Paragraphs 548-550).

I incorporate that analysis by reference.

604. Smith explains that "[a] 2x2 optical cross connect (OXC) 142 links two input fibers 144, 146 connected to input ports IN, IN to two output fibers 148, 150 connected to ***output ports OUT, OUT***," that "the invention is directly applicable to a larger number of input and output fibers," and that "[f]or an add/drop multiplexer, the four fibers 162, 164, 166, 168 correspond respectively, for example, to IN, OUT, ADD, and ***DROP***." *See* Smith at 8:40-46, 12:4-12; *see also id.* at 3:66-4:24, 8:47-59, 12:29-42, Figs. 5, 6, 8-13; *see also* Smith Prov. at 3:16-4:17, 7:6-8:4, Fig. 1-6. A POSITA would understand that a pass-through port could receive a subset of spectral channels, particularly where there are multiple pass-through ports or a drop port.

605. Therefore, Smith discloses to a POSITA "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels."

(xciv) *'906 Patent, [116] "The optical system of claim 115 further comprising a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports"*

606. I previously analyzed Smith in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.b.ix (Paragraphs 483-484);
- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.b.x (Paragraphs 485-486); and
- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.b.liii (Paragraphs 551-552).

I incorporate that analysis by reference.

(xcv) *'906 Patent, [117] "The optical system of claim 116 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

607. I previously analyzed Smith in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power

levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.b.ix (Paragraphs 483-484); and

- "said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors[,]" discussed above in Section IX.1.b.liv (Paragraph 553).

I incorporate that analysis by reference.

(xcvi) *'906 Patent, [118] "The optical system of claim 115 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimators, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports."*

608. I previously analyzed Smith in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]" discussed above in Section IX.1.b.xiii (Paragraphs 491-492);
- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.b.xlvii (Paragraph 542); and
- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.b.lvi (Paragraphs 555-556).

I incorporate that analysis by reference.

(xcvii) *'906 Patent, [122] "The optical system of claim 115 wherein each channel micromirror is a silicon micromachined mirror."*

609. I previously analyzed Smith in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.b.lvii (Paragraphs 557-558).

I incorporate that analysis by reference.

(xcviii) *'906 Patent, [123] "The optical system of claim 115 wherein said beam-focuser comprises a focusing lens having first and second focal points, and wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points"*

610. To the extent Smith does not disclose "wherein said beam-focuser comprises a focusing lens having first and second focal points, and wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xcix) *'906 Patent, [124] "The optical system of claim 115 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

611. I previously analyzed Smith in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.b.xvii (Paragraphs 499-500).

I incorporate that analysis by reference.

(c) *'906 Patent, [125] "The optical system of claim 115 further comprising a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors"*

612. I previously analyzed Smith in view of the following limitations:

- "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors[,]"discussed above in Section IX.1.b.lxiii (Paragraph 565).

I incorporate that analysis by reference.

(ci) *'906 Patent, [126-pre] "The optical system of claim 115 further comprising an auxiliary wavelength-separating-routing apparatus, including:"*

613. I previously analyzed Smith in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]"discussed above in Section IX.1.b.xlviii (Paragraph 543); and
- "An optical system comprising a wavelength-separating-routing apparatus, wherein said wavelength-separating-routing apparatus includes[,]" discussed above in Section IX.1.b.lxxxviii (Paragraphs 595-596).

I incorporate that analysis by reference.

614. To the extent the language in the preamble is considered limiting, a POSITA would understand that the disclosed WDM add/drop multiplexer in Smith could also be used as "an auxiliary wavelength-separating-routing apparatus." Therefore, Smith discloses to a POSITA "an auxiliary wavelength-separating-routing apparatus."

(cii) *'906 Patent, [126-a] "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports"*

615. I previously analyzed Smith in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466);

I incorporate that analysis by reference.

616. A POSITA would understand that the disclosed fiber collimator in Smith could be used as "[an] auxiliary input port[]." Furthermore, Smith explains that "the invention is directly applicable to a larger number of input and output fibers." *See* Smith at 8:45-46. A POSITA would understand that a system with a larger number of input and output fibers would also have a larger number of fiber collimators, which would be formed in an array. Therefore, under Capella's apparent interpretation, Smith discloses to a POSITA "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports."

(ciii) *'906 Patent, [126-b] "an exiting port"*

617. I previously analyzed Smith in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466).

I incorporate that analysis by reference.

618. A POSITA would understand that "an exiting port" is "an output port." Therefore, Smith discloses to a POSITA "an exiting port."

(civ) *"'906 Patent, [126-c] "an auxiliary wavelength-separator"*

619. I previously analyzed Smith in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.b.vi (Paragraphs 474-475).

I incorporate that analysis by reference.

620. A POSITA would understand that the disclosed wavelength-separator in Smith could be used as "an auxiliary wavelength-separator."

(cv) *'906 Patent, [126-d] "an auxiliary beam-focuser"*

621. I previously analyzed Smith in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.b.xvi (Paragraphs 497-498).

I incorporate that analysis by reference.

622. A POSITA would understand that the disclosed beam-focuser in Smith could be used as "an auxiliary beam-focuser."

(cvi) *'906 Patent, [126-e] "a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors"*

623. I previously analyzed Smith in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports

and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.b.lii (Paragraphs 548-550).

I incorporate that analysis by reference.

624. A POSITA would understand that the disclosed spatial array of channel micromirrors in Smith could be used as "a spatial array of auxiliary channel micromirrors."

> **(cvii)** *'906 Patent, [127] "The optical system of claim 126 wherein said auxiliary channel micromirrors are individually pivotable."*

625. Smith discloses to a POSITA "wherein said auxiliary channel micromirrors are individually pivotable." For example, Smith explains that "[t]he MEMS array 204 is preferably formed as a two dimensional array of ***dual-axis tiltable mirrors***" and "includes a gimbal structure of an outer frame 262 twistably supported in a support structure 264 of the MEMS array through a first pair of torsion beams 266 extending along and ***twisting about a minor axis*** [and] a mirror plate 268 having a reflective surface 270 twistably supported on the outer frame 262 through a second pair of torsion beams 272 ***arranged along a major axis perpendicular to the minor axis and twisting thereabout***." *See* Smith at 14:49-65 (emphasis added); *see also id.* at Abstract, 3:66-4:12, 4:40-42, 4:56-60; 5:27-32, 7:32-44, 8:19-20, 12:39-50, 15:35-54, 16:9-51, 19:51-55, Figs. 5, 6, 14, 16; *see also* Smith Prov. at 3:16-24, 6:3-7, 7:29-8:2, 8:5-11, 9:4-23, 10:1-20, Figs. 1-3, 6, 7.

626. Therefore, Lalonde discloses to a POSITA "wherein said auxiliary channel micromirrors are individually pivotable."

> **(cviii)** *'906 Patent, [129] "The optical system of claim 126 wherein each auxiliary channel micromirror is a silicon micromachined mirror"*

627. I previously analyzed Lalonde in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.b.lvii (Paragraphs 557-558).

628. I incorporate that analysis by reference.

(cix) *'906 Patent, [130] "The optical system of claim 126 wherein said auxiliary wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

629. I previously analyzed Lalonde in view of the following limitations:

  - "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.b.xvii (Paragraphs 499-500).

630. I incorporate that analysis by reference.

(cx) *'906 Patent, [131] "The optical system of claim 126 wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports."*

631. Under Capella's apparent interpretation, Smith discloses to a POSITA "wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports." For example, Smith explains that "[a] 2x2 optical cross connect (OXC) 142 links two input fibers 144, 146 connected to input ports IN, IN to two output fibers 148, 150 connected to ***output ports OUT, OUT***," that "the invention is directly applicable to a larger number of input and output fibers," and that "[f]or an add/drop multiplexer, the four fibers 162, 164, 166, 168 correspond respectively, for example, to IN, OUT, ADD, and ***DROP***." *See* Smith at 8:40-46, 12:4-12; *see also id.* at 3:66-4:24, 8:47-59, 12:29-42, Figs. 5, 6, 8-13; *see also* Smith Prov. at 3:16-4:17, 7:6-8:4, Fig. 1-6.

632. Therefore, under Capella's apparent interpretation, Smith discloses to a POSITA "wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports."

(cxi) *'906 Patent, [132] "The optical system of claim 115, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator."*

633. I previously analyzed Smith in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.b.xix (Paragraphs 503-504).

I incorporate that analysis by reference.

(cxii) *'906 Patent, [133] "A method of performing dynamic wavelength separating and routing, comprising"*

634. I previously analyzed Smith in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]"discussed above in Section IX.1.b.xlviii (Paragraph 543).

I incorporate that analysis by reference.

635. To the extent the language in the preamble is considered limiting, a POSITA would understand that the disclosed WDM add/drop multiplexer in Smith would also disclose "[a] method of performing dynamic wavelength separating and routing." Therefore, Lalonde discloses to a POSITA "[a] method of performing dynamic wavelength separating and routing."

(cxiii) *'906 Patent, [133-a] "receiving a multi-wavelength optical signal from a fiber collimator input port"*

636. I previously analyzed Smith in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.b.ii (Paragraphs 464-466); and

- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports [,]" discussed above in Section IX.1.b.xlix (Paragraphs 544-545).

I incorporate that analysis by reference.

(cxiv) *'906 Patent, [133-b] "separating said multi-wavelength optical signal into multiple spectral channels"*

637. I previously analyzed Smith in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.b.vi (Paragraphs 474-475).

I incorporate that analysis by reference.

(cxv) *'906 Patent, [133-c] "focusing said spectral channels onto a spatial array of corresponding beam-deflecting elements, whereby each beam-deflecting element receives one of said spectral channels"*

638. I previously analyzed Smith in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.b.xvi (Paragraphs 497-498); and
- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels," discussed above in Section IX.1.b.vii (Paragraphs 476-480).

I incorporate that analysis by reference.

(cxvi) *'906 Patent, [133-d] "dynamically and continuously controlling said beam-deflecting elements in two dimensions to direct said spectral channels into any selected ones of output ports and to control the power of the spectral channels coupled into said selected output ports"*

639. I previously analyzed Smith in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.b.viii (Paragraphs 481-482);
- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.b.ix (Paragraphs 483-484);
- "said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal[,]" discussed above in Section IX.1.b.xiv (Paragraphs 493-494);
- "controlling dynamically and continuously said beam-deflecting elements in two dimensions[,]"discussed above in Section IX.1.b.xli (Paragraphs 534-535);
- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port [,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.b.lii (Paragraphs 548-550).

I incorporate that analysis by reference.

> **(cxvii)** *'906 Patent, [134] "The method of claim 133 further comprising the step of providing feedback control of said beam-deflecting elements to maintain a predetermining coupling of each spectral channel directed into one of said output ports."*

640. I previously analyzed Smith in view of the following limitations:

- "a spatial array of beam-deflecting elements[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480);
- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.b.ix (Paragraphs 483-484);
- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.b.x (Paragraphs 485-486); and
- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said

fiber collimator output ports[,]" discussed above in Section IX.1.b.liii (Paragraphs 551-552).

I incorporate that analysis by reference.

(cxviii) *'906 Patent, [135] "The method of claim 134 further comprising the step of maintaining power levels of said spectral channels directed into said output ports at a predetermining value."*

641. I previously analyzed Smith in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.b.ix (Paragraphs 483-484); and
- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.b.x (Paragraphs 485-486).

I incorporate that analysis by reference.

(cxix) *'906 Patent, [137] "The method of claim 133 wherein a subset of said spectral channels is directed into one of said output ports, thereby providing one or more pass-through spectral channels."*

642. I previously analyzed Smith in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.b.vii (Paragraphs 476-480); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.b.lii (Paragraphs 548-550); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels[,]"discussed above in Section IX.1.b.xciii (Paragraphs 603-605).

I incorporate that analysis by reference.

(cxx) *'906 Patent, [138] "The method of claim 137 further comprising the step of multiplexing said pass-through spectral channels with one or more add spectral channels, so as to provide an output optical signal."*

643. I previously analyzed Smith in view of the following limitations:

- "wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said

auxiliary channel micromirrors [,]"discussed above in Section IX.1.b.cvi (Paragraphs 623-624).

I incorporate that analysis by reference.

(cxxi) *'906 Patent, [139] "The method of claim 133 wherein said beam-deflecting elements comprise an array of silicon micromachined mirrors."*

644. I previously analyzed Smith in view of the following limitations:

- "a spatial array of beam-deflecting elements[,]"discussed above in Section IX.1.b.vii (Paragraphs 476-480);
- "a spatial array of channel micromirrors[,] discussed above in Section IX.1.b.lii (Paragraphs 548-550); and
- "wherein each channel micromirror is a silicon micromachined mirror[,]" discussed above in Section IX.1.b.lvii (Paragraphs 557-558).

I incorporate that analysis by reference.

c) U.S. Patent No. 6,097,859 ("Solgaard")

645. Solgaard is directed to "[a] cross-connect switch for fiber-optic communication networks employing a wavelength dispersive element . . . and a stack of regular (non-wavelength selective) cross bar switches using two-dimensional arrays of micromachined, electrically actuated, individually-tiltable, controlled deflection micro-mirrors for providing multiport switching capability for a plurality of wavelengths." *See* Solgaard at Abstract. As shown in Figure 1, reproduced below, the switch includes three input fibers (reference numerals 14a-c), a first diffraction grating-lens system (reference numeral 16), a spatial micromechanical switching matrix (reference numeral 20), a second diffraction grating-lens system (reference numeral 22), and three output fibers (reference numerals 24a-c). *See id.* at Fig. 1, 3:54-4:1.

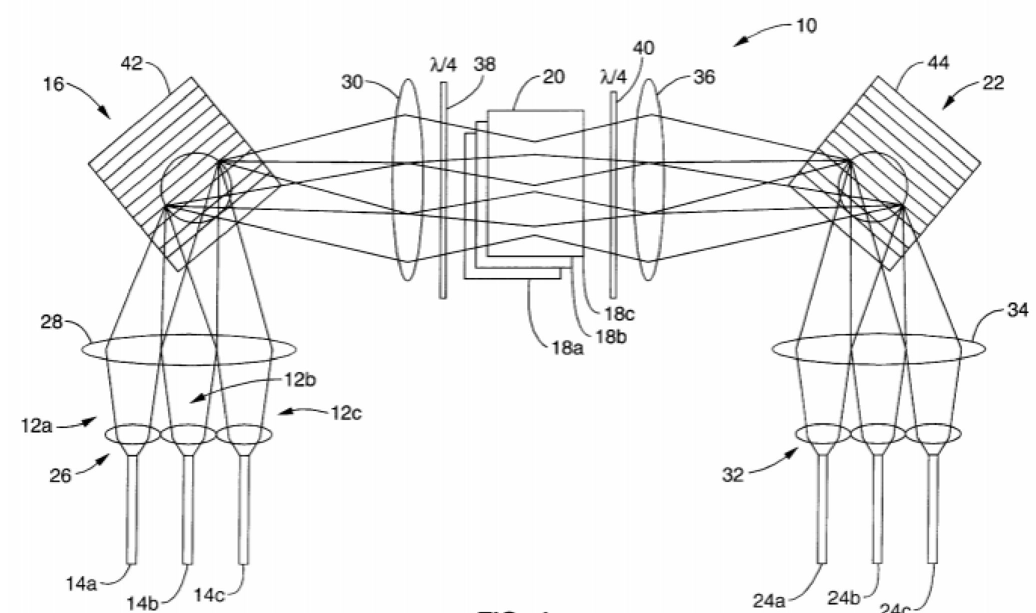


FIG. 1

646. Each input fiber has a corresponding wavelength channel (reference numerals 12a-c). *See id.* The wavelength channels are "collimated and spatially dispersed by [the] first . . . diffraction grating-lens system," and "the dispersed wavelength channels are then focused onto a corresponding layer (reference numerals 18a-c) of [the] spatial micromechanical switching matrix." *See id.* Finally, the resulting wavelength channels (*i.e.*, the spatially reorganized wavelength channels) are "collimated and recombined by [the] second . . . diffraction grating-lens system 22 onto [the] three output fibers." *See id.*

647. Figure 2, reproduced below, depicts "a schematic plan view of a single layer 18a of the switching matrix 20 of [Figure] 1." *See id.* at Fig. 2, 4:9-22. In Figure 2, reproduced below, "six micromirrors [(reference numerals 46a-f)] are arranged in two arrays [(reference numerals 48a, 48b)] that can be individually controlled so as to optically 'couple' any of the three input fibers . . . to any of the three output fibers." *See id.*

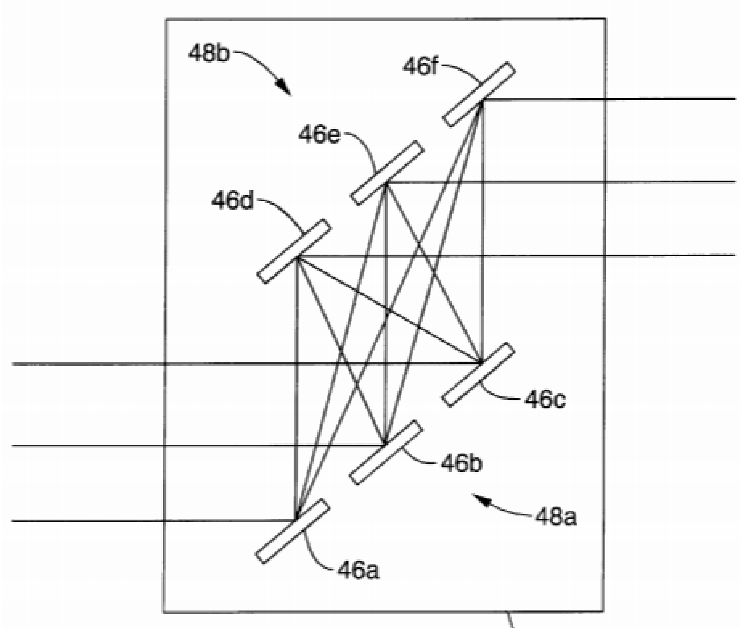


FIG. 2

(i) *Solgaard Is Prior Art to the Asserted Claims*

648. Solgaard claims priority to U.S. Provisional Application No. 60/038,172, filed on February 13, 1997, and its application was filed on February 12, 1998 and issued on August 1, 2000. Accordingly, Solgaard is prior art to the '905 and '906 Patents under at least pre-AIA 35 U.S.C. § 102(a) and/or (b) and (e).

(ii) *'905 Patent, [23-pre]: "An optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports, the apparatus comprising"*

649. To the extent the language in the preamble is considered limiting, under Capella's apparent interpretation, Solgaard discloses to a POSITA "[a]n optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports." For example, Solgaard "relates to ***a cross-connect switch for fiber optic communication networks*** including wavelength division multiplexed (WDM) networks, and more particularly to such an optical switch using a matrix of individually tiltable micro-mirrors." *See id.* at 1:19-

23 (emphasis added); *see also id.* at Abstract. Specifically, Solgaard provides "a fiber-optic switch using two arrays of actuated mirrors ***to switch or rearrange signals from N input fibers onto N output fibers***, where the number of fibers, N, can be two, or substantially larger than 2." *See id.* at 1:63-67 (emphasis added); *see also id.* at 3:54-4:1, Fig. 1. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

650. Therefore, under Capella's apparent interpretation, Solgaard discloses to a POSITA "[a]n optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports."

(iii) *'905 Patent, [23-a] "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels"*

651. Under Capella's apparent interpretation, Solgaard discloses to a POSITA "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels." Solgaard provides "a fiber-optic switch using two arrays of actuated mirrors to switch or rearrange signals from ***N input fibers*** onto N output fibers, where the number of fibers, N, can be two, or substantially larger than 2." *See id.* at 1:63-67 (emphasis added). Solgaard further explains that "***the wavelength channels 12a, 12b, 12c of three input fibers 14a, 14b, 14c are collimated*** and spatially dispersed by a first (or input) diffraction grating-lens system 16." *See id.* at 3:54-4:1 (emphasis added); *see also id.* at Fig. 1. A POSITA would understand the wavelength channels to be spectral channels such that, *e.g.*, wavelength channel 12a could be a first spectral channel. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

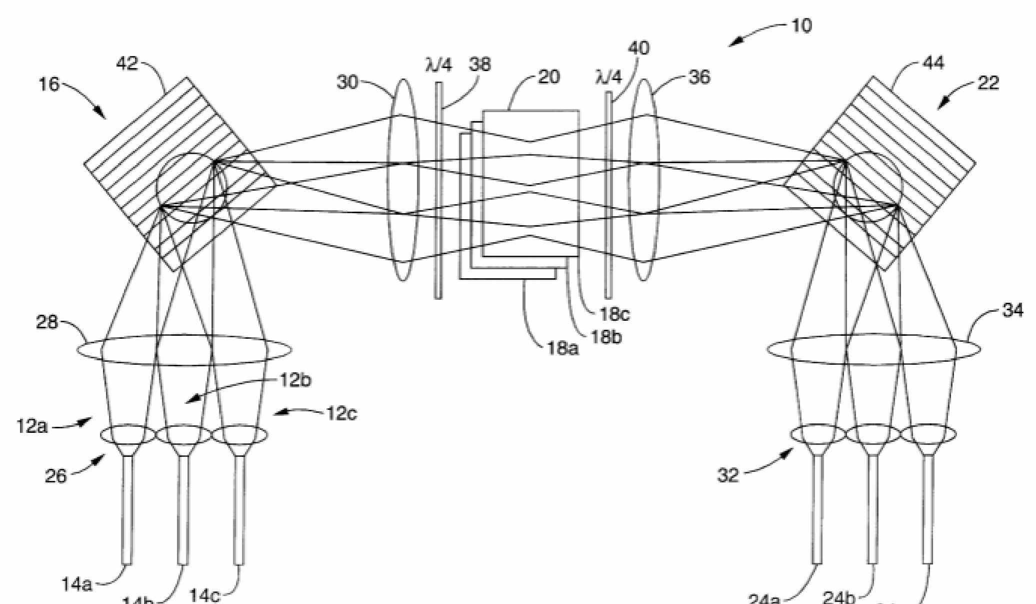


FIG. 1

652. Additionally, Figure 8, reproduced below, depicts an arrangement where "WDM optical signals 66 emanating from ***an input fiber 68 would be collimated*** and diffracted from the grating 70 forming a high resolution spatially dispersed spectrum at the lens 72 focal plane." *See id.* at 8:59-66, Fig. 8 (emphasis added).

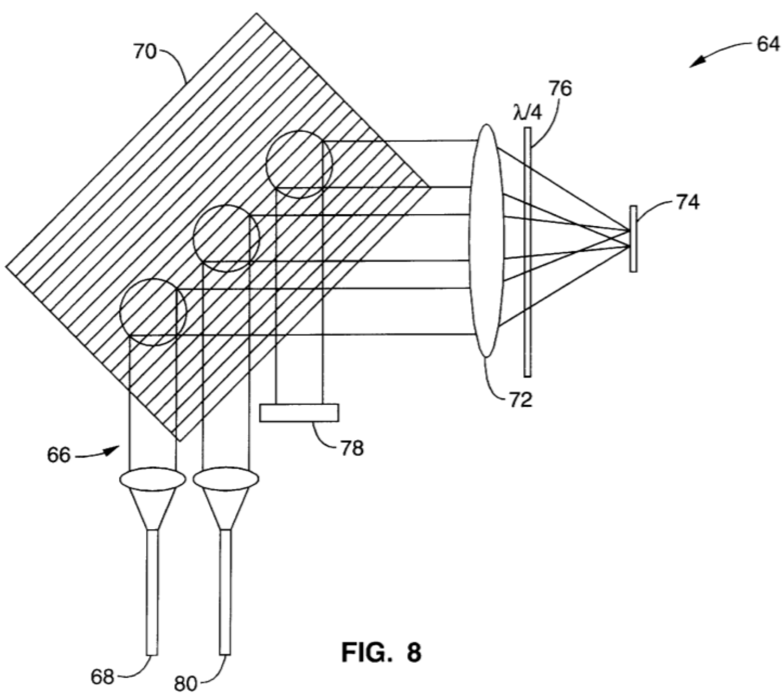


FIG. 8

653. Therefore, under Capella's apparent interpretation, Solgaard discloses to a POSITA "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels."

(iv) *'905 Patent, [23-b] "the fiber collimator one or more other ports for second spectral channels"*

654. Under Capella's apparent interpretation, Solgaard discloses to a POSITA "the fiber collimator one or more other ports for second spectral channels." Solgaard provides "a fiber-optic switch using two arrays of actuated mirrors to switch or rearrange signals from ***N input fibers*** onto N output fibers, where the number of fibers, ***N, can be two, or substantially larger than 2***." *See id.* at 1:63-67 (emphasis added). Solgaard further explains that "***the wavelength channels 12a, 12b, 12c of three input fibers 14a, 14b, 14c are collimated*** and spatially dispersed by a first (or input) diffraction grating-lens system 16." *See id.* at 3:54-4:1 (emphasis added); *see also id.* at Fig. 1. A POSITA would understand the wavelength channels to be spectral channels such that, *e.g.*, wavelength channel 12b could be a second spectral channel. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

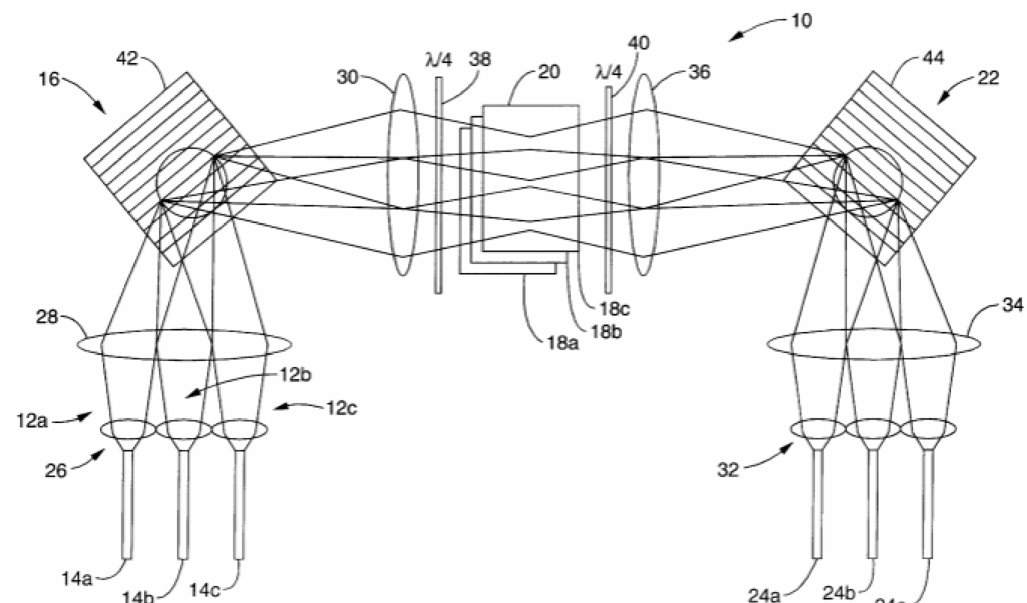


FIG. 1

655. Additionally, Figure 8, reproduced below, depicts an arrangement where "WDM optical signals 66 emanating from ***an input fiber 68 would be collimated*** and diffracted from the grating 70 forming a high resolution spatially dispersed spectrum at the lens 72 focal plane." *See id.* at 8:59-66, Fig. 8 (emphasis added).

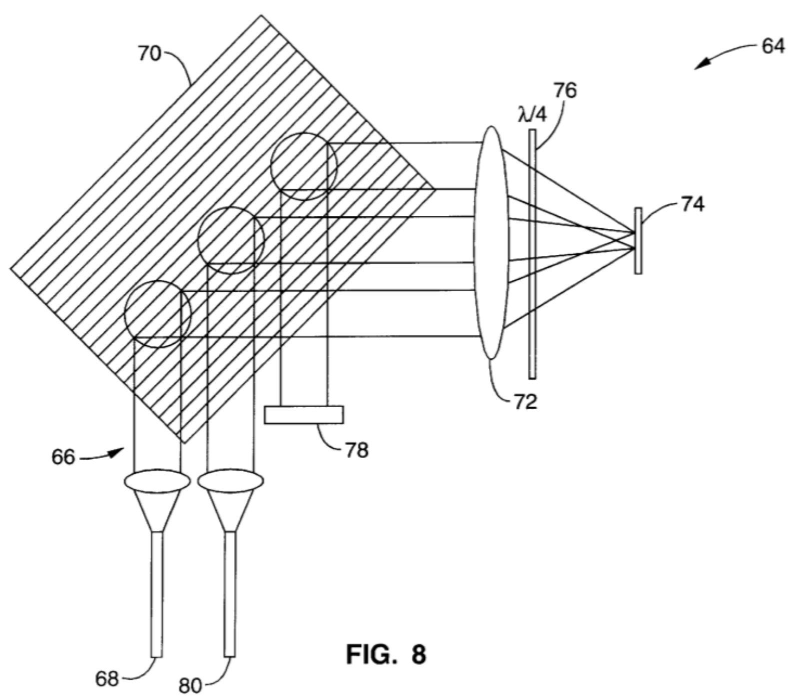


FIG. 8

656. Therefore, under Capella's apparent interpretation, Solgaard discloses to a POSITA "the fiber collimator one or more other ports for second spectral channels."

(v) *'905 Patent, [23-c] "the output port for an output multi-wavelength optical signal"*

657. Solgaard discloses to a POSITA "the output port for an output multi-wavelength optical signal." Solgaard provides "a fiber-optic switch using two arrays of actuated mirrors to switch or rearrange signals from N input fibers onto ***N output fibers***, where the number of fibers, N, can be two, or substantially larger than 2." *See id.* at 1:63-67 (emphasis added). Solgaard further explains that "[t]he spatially reorganized wavelength channels are finally collimated and recombined by a second (or output) diffraction grating-lens system 22 onto ***three output fibers 24a, 24b, 24c***." *See id.* at 3:54-4:1 (emphasis added); *see also id.* at Fig. 1.

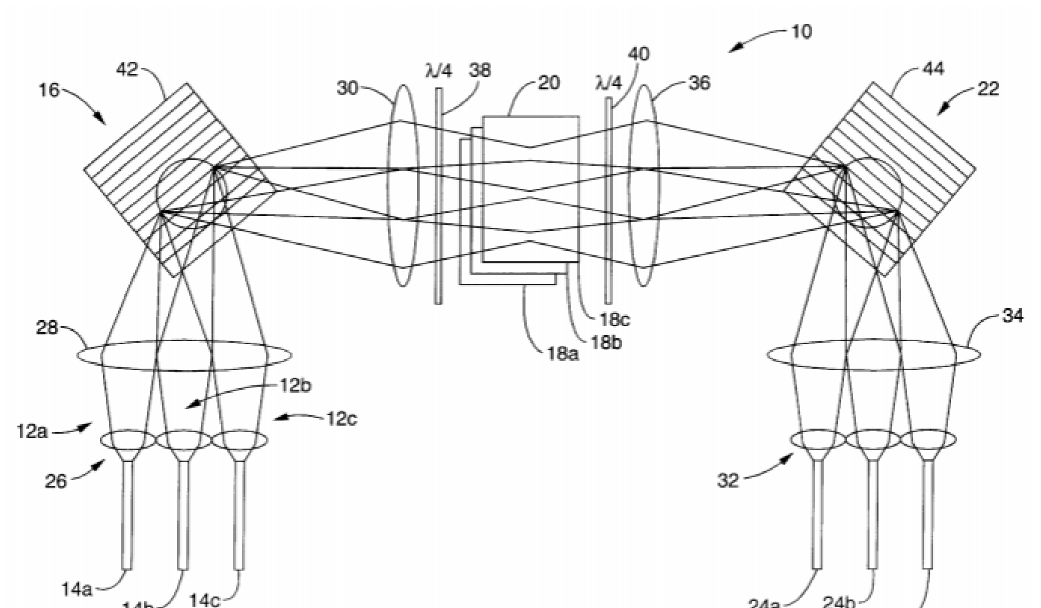


FIG. 1

658. Therefore, Solgaard discloses to a POSITA "the output port for an output multi-wavelength optical signal."

(vi) *'905 Patent, [23-d] "a wavelength-selective device for spatially separating said spectral channels"*

659. Solgaard discloses to a POSITA "a wavelength-selective device for spatially separating said spectral channels." As shown in Figure 1, reproduced below, "the wavelength channels 12a, 12b, 12c of three input fibers 14a, 14b, 14c are collimated and ***spatially dispersed by a first (or input) diffraction grating-lens system 16***." *See id.* at 3:54-4:1, Fig. 1 (emphasis added). Solgaard further explains that "[t]he grating-lens system 16 ***separates the wavelength channels*** in a direction perpendicular to the plane of the paper." *See id.* (emphasis added).

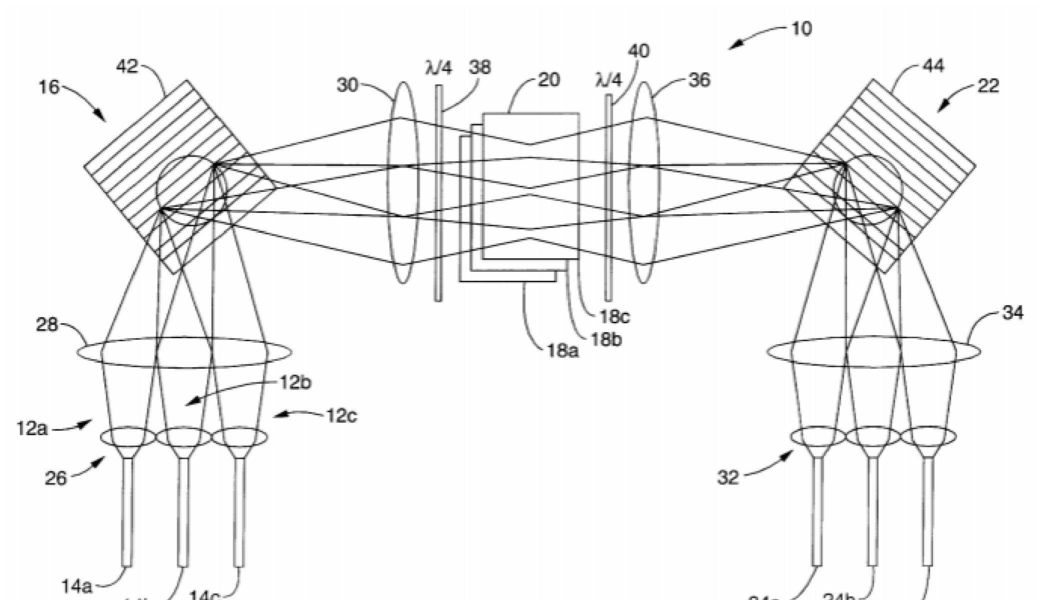


FIG. 1

660. Therefore, Solgaard discloses to a POSITA "a wavelength-selective device for spatially separating said spectral channels."

(vii) *'905 Patent, [23-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port"*

661. Solgaard discloses to a POSITA "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port." Solgaard "us[es] two-dimensional arrays of ***micromachined, electrically actuated, individually-tiltable, controlled deflection micro-mirrors*** for providing multiport switching capability for a plurality of wavelengths." *See id.* at Abstract (emphasis added).

662. Solgaard discloses "a spatial array of beam-deflecting elements." The disclosed spatial micromechanical switching matrix in Solgaard has multiple layers, and each layer includes micromirrors arranged in arrays. *See id.* at 3:54-4:1, 4:9-22, Figs. 1, 2. For instance, Figure 2, reproduced below, depicts an arrangement with "six micromirrors . . . arranged in two arrays." *See id.* at 4:9-22, Fig. 2.

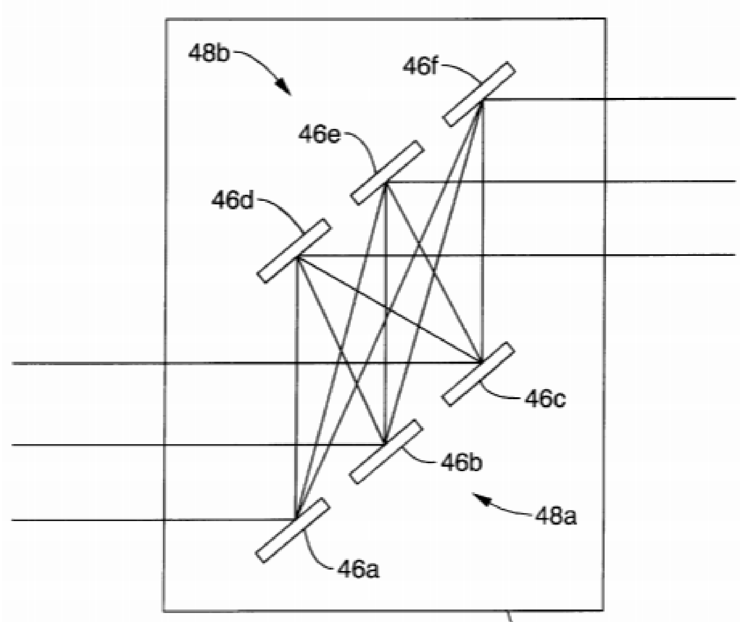


FIG. 2

663. Solgaard further discloses "that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port." For example, the micromirrors "can be ***individually controlled*** so as to optically 'couple' any of the three ***input fibers*** . . . to any of the three ***output fibers*** . . . ." *See id.* (emphasis added).

664. Figure 3, reproduced below, depicts "an example of the structural configuration of a row of individually tiltable micromirrors on the switch array." *See id.* Each micromirror "is suspended by a pair of torsion bars or flexing beams 50a, 50b attached to posts 52a, 52b, respectively." *See id.*

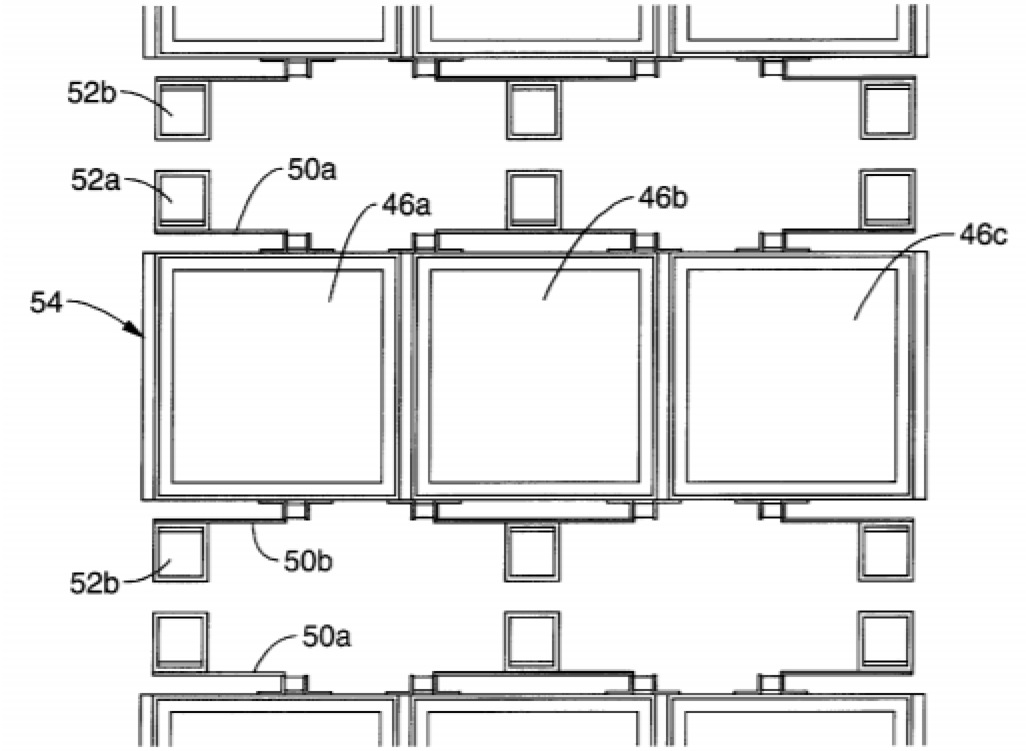


FIG. 3

Solgaard explains that:

> Referring again to FIG. 3, the switching matrix design shown is compatible with the MUMP (the Multiuser Micro Electro-Mechanical System Process at the Microelectronics Center of North Carolina) and its design rules. The full switching matrix includes two arrays each with eight rows of the mirrors shown. The mirrors are actuated by an electrostatic field applied between the mirror and an electrode underneath (not shown). Each of the mirrors in the switching matrix has three states, but the mirrors in the three rows do not operate identically. The central mirror may send the beam to either side, while the outer mirrors only deflect to one side. According to one design, the two on the sides are mirror images of each other, the center mirror being either in the flat state (no voltage applied) or brought down to the point where it touches the substrate on either side. The electrode under the central mirror is split in two to allow it to tilt either way. The side mirrors also have a state that is half way between the flat state and the fully pulled-down state. ***This may be achieved by having continuous control over the mirror angles***. Although this is complicated by the electromechanical instability of parallel plate capacitors because, as the voltage on the plates is increased, the capacitance goes up and this leads to a spontaneous pulling down of the mirror when the voltage is increased past a certain value, this effect can be

> avoided either by controlling the charge rather than the voltage on the capacitors, or by using an electrode geometry that pushes the instability point past the angle to be accessed. Charge control utilizes the full range of motion of the mirrors but complicates the driver circuitry for the switch. It may be preferable to use electrode geometry to achieve the required number of states.

See id. at 6:57-7:20 (emphasis added).

665. Therefore, Solgaard discloses to a POSITA "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port."

(viii) *'905 Patent, [24] "The optical add-drop apparatus of claim 23 further comprising a control unit for controlling each of said beam-deflecting elements"*

666. Solgaard discloses to a POSITA "a control unit for controlling each of said beam-deflecting elements." Solgaard "us[es] two-dimensional arrays of ***micromachined, electrically actuated, individually-tiltable, controlled deflection micro-mirrors*** for providing multiport switching capability for a plurality of wavelengths." *See id.* at Abstract (emphasis added). As explained above, the beam-deflecting elements of Solgaard are individually and continuously controllable. *See supra* Section IX.1.c.vii; *see also* Solgaard at 4:9-22, 6:57-7:20, Figs. 2, 3. A POSITA would understand that the beam-deflecting elements of Solgaard would be controlled with a control unit such as an integrated circuit.

667. Solgaard further explains that:

> Referring again to FIG. 3, ***the switching matrix design shown is compatible with the MUMP (the Multiuser Micro Electro-Mechanical System Process at the Microelectronics Center of North Carolina) and its design rules***. The full switching matrix includes two arrays each with eight rows of the mirrors shown. The mirrors are actuated by an electrostatic field applied between the mirror and

> an electrode underneath (not shown). Each of the mirrors in the switching matrix has three states, but the mirrors in the three rows do not operate identically. The central mirror may send the beam to either side, while the outer mirrors only deflect to one side. According to one design, the two on the sides are mirror images of each other, the center mirror being either in the flat state (no voltage applied) or brought down to the point where it touches the substrate on either side. The electrode under the central mirror is split in two to allow it to tilt either way. The side mirrors also have a state that is half way between the flat state and the fully pulled-down state. This may be achieved by having continuous control over the mirror angles. Although this is complicated by the electromechanical instability of parallel plate capacitors because, as the voltage on the plates is increased, the capacitance goes up and this leads to a spontaneous pulling down of the mirror when the voltage is increased past a certain value, this effect can be avoided either by controlling the charge rather than the voltage on the capacitors, or by using an electrode geometry that pushes the instability point past the angle to be accessed. ***Charge control utilizes the full range of motion of the mirrors*** but complicates the driver circuitry for the switch. It may be preferable to use electrode geometry to achieve the required number of states.

See id. at 6:57-7:20 (emphasis added).

668. Therefore, Solgaard discloses to a POSITA "a control unit for controlling each of said beam-deflecting elements."

(ix) *'905 Patent, [25] "The optical add-drop apparatus of claim 24, wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements"*

669. Solgaard discloses to a POSITA "a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements." For example, Solgaard explains that "the fiber-optic switch of the present invention can be used in connection with diagnostic tools for WDM networks." Solgaard at 8:35-37. Solgaard further explains that "WDM network management systems and software require knowledge of the state of the entire network" and that "[t]he manager requires confirmation of whether or not a channel is active, ***its power*** and how much a channel optical frequency has drifted as well as the noise power level." *Id.* at 8:37-43. Solgaard

notes that this information "permits management software to identify, isolate, and potentially rectify or route around physical layer faults." *Id.* at 8:44-46.

670. Therefore, Solgaard discloses to a POSITA "a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements." To the extent Solgaard does not teach "a servo-control assembly[,]" this limitation would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(x) *'905 Patent, [26] "The optical add-drop apparatus of claim 25, wherein said servo-control assembly maintains said power levels at predetermined values"*

671. To the extent Solgaard does not teach "wherein said servo-control assembly maintains said power levels at predetermined values[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xi) *'905 Patent, [27] "The optical add-drop apparatus of claim 24, wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal"*

672. Solgaard discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal." For example, Solgaard explains that "[m]ulti-port, multi-wavelength cross-connect optical switches" can "provide an add-drop capability to the 2×2 switch fabric." Solgaard at 1:25-42.

673. Therefore, Solgaard discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal."

(xii) *'905 Patent, [28] "The optical add-drop apparatus of claim 24, wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal"*

674. Solgaard discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal." Solgaard "us[es] two-dimensional arrays of ***micromachined, electrically actuated, individually-tiltable, controlled deflection micro-mirrors*** for providing multiport switching capability for a plurality of wavelengths." *See id.* at Abstract (emphasis added). As explained above, the beam-deflecting elements of Solgaard are individually and continuously controllable. *See supra* Section IX.1.c.vii; *see also* Solgaard at 4:9-22, 6:57-7:20, Figs. 2, 3. Furthermore, these micromirrors "optically 'couple' any of the three input fibers . . . to any of the three output fibers." *See id.* at 4:9-22. A POSITA would understand that the beam-deflecting elements of Solgaard would be controlled with a control unit such as an integrated circuit.

675. Therefore, Solgaard discloses to a POSITA "a control unit for controlling each of said beam-deflecting elements."

(xiii) *'905 Patent, [29] "The optical add-drop apparatus of claim 23 further comprising alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device"*

676. Solgaard discloses to a POSITA "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device."

677. Solgaard discloses:

> Referring first to FIG. 1, a multi-port (NXN ports), multiwavelength (M wavelength) WDM cross-connect switch 10 embodying this invention is schematically shown where, in the example shown, N=3. In this switch 10, the wavelength channels 12a, 12b, 12c of three input fibers 14a, 14b, 14c are collimated and spatially dispersed by a first (or input) diffraction grating-lens system 16. The grating-lens system 16 separates the wavelength channels in a direction perpendicular to the plane of the paper, and the dispersed wavelength channels are then focused onto a corresponding layer 18a, 18b, 18c of a spatial micromechanical switching matrix 20. The spatially reorganized wavelength channels are finally collimated and recombined by a second (or output) diffraction grating-lens system 22 onto three output fibers 24a, 24b, 24c. The input and output lens systems are each composed of a lenslet array 26 (32) and a pair of bulk lenses 28, 30 (34,36) such that the spot size and the spot separation on the switching matrix 20 can be individually controlled. Two quarter-wave plates 38, 40 are inserted symmetrically around the micromechanical switching matrix 20 to compensate for the polarization sensitivity of the gratings 42, 44, respectively. Referring now to FIG. 2, a schematic plan view of a single layer 18a of the switching matrix 20 of FIG. 1 is shown. As can be seen in FIG. 2, ***six micromirrors 46a through 46f are arranged in two arrays 48a, 48b that can be individually controlled so as to optically "couple" any of the three input fibers 14a, 14b, 14c to any of the three output fibers 24a, 24b, 24c***. Referring also to FIG. 3, an example of the structural configuration of a row of individually tiltable micromirrors on the switch array can be seen. As shown in FIG. 3, each mirror 46a, 46b, 46c is suspended by a pair of torsion bars or flexing beams 50a, 50b attached to posts 52a, 52b, respectively. Note that each mirror also includes a landing electrode 54 on which the mirrors land when they are deflected all the way down to the substrate.

See id. at 3:54-4:22; *see also id.* at FIG. 1. A POSITA would understand the micromirrors in Solgaard allow for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device.

678. Therefore, Solgaard discloses to a POSITA "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device."

> **(xiv)** *'905 Patent, [31] "The optical add-drop apparatus of claim 23, wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal"*

679. Solgaard discloses to a POSITA "wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal." Solgaard explains that "[t]he spatially reorganized wavelength channels are finally collimated and ***recombined*** by a second (or output) diffraction grating-lens system 22 onto three output fibers." *See id.* at 3:54-4:1, Fig. 1 (emphasis added).

680. Therefore, Solgaard discloses to a POSITA "wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal."

> **(xv)** *'905 Patent, [32] "The optical add-drop apparatus of claim 23, wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels"*

681. To the extent Solgaard does not teach "wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(xvi)** *'905 Patent, [33] "The optical add-drop apparatus of claim 23 further comprising a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements"*

682. Solgaard discloses to a POSITA "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements." Solgaard explains that "the dispersed wavelength channels are then ***focused*** onto a corresponding layer . . . of a spatial micromechanical switching matrix." *See id.* at 3:54-4:4, Fig. 1 (emphasis added). Solgaard further explains that "[a] ***focusing*** lens (not shown) would be placed in the return path of the reflected, and suitably displaced, return beam after a second grating diffraction from grating." *See id.* at 8:59-9:12, Fig. 8 (emphasis added).

683. Therefore, Solgaard discloses to a POSITA "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements."

> **(xvii)** *'905 Patent, [34] "The optical add-drop apparatus of claim 23, wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms"*

684. Solgaard discloses to a POSITA "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms." For example, Solgaard "provide[s] a fiber-optic switch as described above, using diffraction gratings as wavelength dispersive elements." *See id.* at 2:47-49. Solgaard also "provide[s] a fiber-optic switch using prisms as wavelength dispersive elements." *See id.* at 2:56-57.

685. Therefore, Solgaard discloses to a POSITA "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."

(xviii) *'905 Patent, [35] "The optical add-drop apparatus of claim 23, wherein said beam-deflecting elements comprise micromachined mirrors"*

686. Solgaard discloses to a POSITA "wherein said beam-deflecting elements comprise micromachined mirrors." For example, Solgaard explains that "[m]irrors of this size, as well as mirrors suitable for larger matrices are easily fabricated by a standard surface micromachining process. This implies that micromachined switching matrices can be scaled to large numbers of fiber channels (e.g., N=16)." *See id.* at 5:46-50; *see also id.* at 2:5-14, 4:9-22.

687. Therefore, Solgaard discloses to a POSITA "wherein said beam-deflecting elements comprise micromachined mirrors."

(xix) *'905 Patent, [37] "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator"*

688. Solgaard discloses to a POSITA "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator." Solgaard explains that "[t]he input fiber 68 and output fiber 80 can be arranged in, a variety of ways. For example, they can be arranged side by side in the plane as shown in FIG.8. An alternative would be to place the output fiber over or under the input fiber. ***A further alternative would be to use the same fiber for the input and output paths, and separate the signals using an optical circulator or the like.***" *See id.* at 9:13-19 (emphasis added). Since "[a] further alternative" is to "us[e] an optical circulator or the like," Solgaard also disclosure not using a circulator.

689. Therefore, Solgaard discloses to a POSITA "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator."

(xx) *'905 Patent, [39] "The optical add-drop apparatus of claim 23, wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array"*

690. Under Capella's apparent interpretation, Solgaard discloses to a POSITA "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array." Solgaard explains that "[t]he input fiber 68 and output fiber 80 can be arranged in, a variety of ways. For example, they can be arranged ***side by side in the plane*** as shown in FIG.8." *See id.* at 9:13-19, Fig. 8 (emphasis added). To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

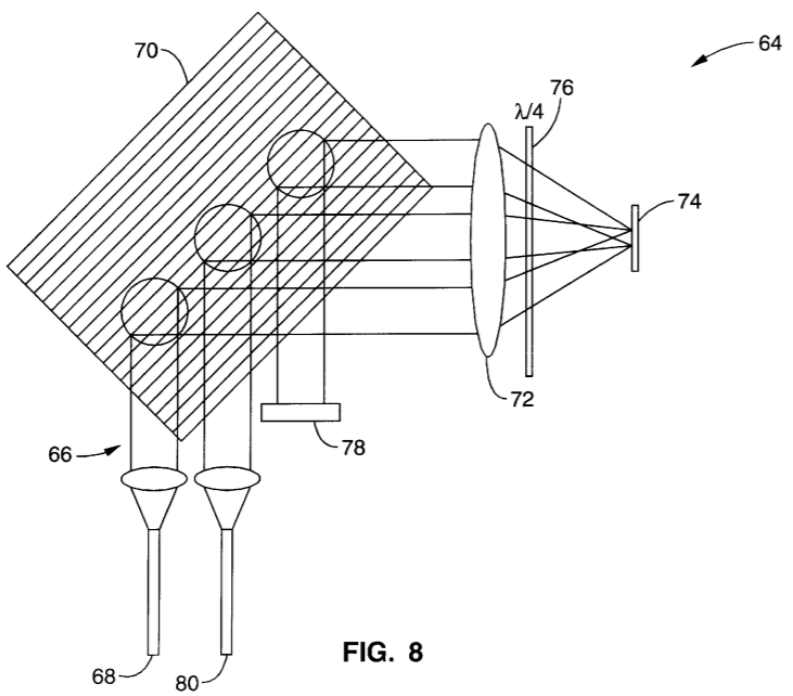


FIG. 8

691. Therefore, under Capella's apparent interpretation, Solgaard discloses to a POSITA "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array."

(xxi) *'905 Patent, [44] "The optical add-drop apparatus of claim 23, further comprising a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels"*

692. Solgaard discloses to a POSITA "a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels." For example, Solgaard explains that "the fiber-optic switch of the present invention can be used in connection with diagnostic tools for WDM networks." Solgaard at 8:35-37. Solgaard further explains that "WDM network management systems and software require knowledge of the state of the entire network" and that "[t]he manager requires confirmation of whether or not a channel is active, ***its power*** and how much a channel optical frequency has drifted as well as the noise power level." *Id.* at 8:37-43. Solgaard notes that this information "permits management software to identify, isolate, and potentially rectify or route around physical layer faults." *Id.* at 8:44-46.

693. Therefore, Solgaard discloses to a POSITA "a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels."

(xxii) *'905 Patent, [45] "The optical add-drop apparatus of claim 44, wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port"*

694. Solgaard discloses to a POSITA "wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one." For example, Solgaard explains that "the fiber-optic switch of the present invention can be used in connection with diagnostic tools for WDM networks." Solgaard at 8:35-37. Solgaard further explains that "WDM network management systems and software require knowledge of the state of the entire network" and that "[t]he manager requires

confirmation of whether or not a channel is active, its power and ***how much a channel optical frequency has drifted as well as the noise power level***." *Id.* at 8:37-43. Solgaard notes that this information "permits management software to identify, isolate, and potentially rectify or route around physical layer faults." *Id.* at 8:44-46.

695. Therefore, Solgaard discloses to a POSITA "wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one."

(xxiii) *'905 Patent, [46] "The optical add-drop apparatus of claim 23, wherein the beam-deflecting elements are micromirrors"*

696. Solgaard discloses to a POSITA "wherein the beam-deflecting elements are micromirrors." For example, Solgaard explains that "[m]irrors of this size, as well as mirrors suitable for larger matrices are easily fabricated by a standard surface micromachining process. This implies that micromachined switching matrices can be scaled to large numbers of fiber channels (e.g., N=16)." *See id.* at 5:46-50; *see also id.* at 2:5-14, 4:9-22.

697. Therefore, Solgaard discloses to a POSITA "wherein the beam-deflecting elements are micromirrors."

(xxiv) *'905 Patent, [47-pre] "An optical add-drop apparatus, comprising"*

698. I previously analyzed Solgaard in view of the following limitations:

- "[a]n optical add-drop apparatus," discussed above in Section IX.1.c.ii (Paragraphs 649-650).

I incorporate that analysis by reference.

(xxv) *'905 Patent, [47-a] "a fiber collimator serving as an input port for an input multi-wavelength optical signal having multiple spectral channels"*

699. I previously analyzed Solgaard in view of the following limitations:

- "fiber collimators serving as an input port . . . ," discussed above in Section IX.1.c.ii (Paragraphs 649-650); and
- "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels[,]" discussed above in Section IX.1.c.iii (Paragraphs 651-653).

I incorporate that analysis by reference.

(xxvi) *'905 Patent, [47-b] "an output port for an output multi-wavelength optical signal"*

700. I previously analyzed Solgaard in view of the following limitations:

- "an output port . . . ," discussed above in Section IX.1.c.ii (Paragraphs 649-650); and
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.c.v (Paragraphs 657-658).

I incorporate that analysis by reference.

(xxvii) *'905 Patent, [47-c] "one or more fiber collimators serving as one or more drop ports for selected spectral channels dropped from said multi-wavelength optical signal"*

701. I previously analyzed Solgaard in view of the following limitations:

- "fiber collimators serving as . . . one or more other ports . . . ," discussed above in Section IX.1.c.ii (Paragraphs 649-650); and
- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.c.xi (Paragraphs 672-673).

I incorporate that analysis by reference.

(xxviii) *'905 Patent, [47-d] "a wavelength-selective device for spatially separating said multiple spectral channels"*

702. I previously analyzed Solgaard in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.c.vi (Paragraphs 659-660).

I incorporate that analysis by reference.

(xxix) *'905 Patent, [47-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports and to control the power of the spectral channel reflected to said output port of the fiber collimator serving as said selected port, whereby a subset of said spectral channels is directed to said fiber collimator serving as said drop ports"*

703. I previously analyzed Solgaard in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665); and
- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.c.xi (Paragraphs 672-673).

I incorporate that analysis by reference.

(xxx) *'905 Patent, [48] "The optical add-drop apparatus of claim 47, wherein none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"*

704. I previously analyzed Solgaard in view of the following limitations:

- "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]" discussed above in Section IX.1.c.xix (Paragraph 688-689).

I incorporate that analysis by reference.

(xxxi) *'905 Patent, [49-pre] "An optical add-drop apparatus, comprising"*

705. I previously analyzed Solgaard in view of the following limitations:

- "[a]n optical add-drop apparatus[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650).

I incorporate that analysis by reference.

(xxxii) *'905 Patent, [49-a] "a fiber collimator serving as an input port for an input multi-wavelength optical signal having multiple spectral channels"*

706. I previously analyzed Solgaard in view of the following limitations:

- "fiber collimators serving as an input port . . .[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650); and
- "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels[,]" discussed above in Section IX.1.c.iii (Paragraphs 651-653).

I incorporate that analysis by reference.

(xxxiii) *'905 Patent, [49-b] "an output port for an output multi-wavelength optical signal"*

707. I previously analyzed Solgaard in view of the following limitations:

- "an output port . . . ," discussed above in Section IX.1.c.ii (Paragraphs 649-650); and
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.c.v (Paragraphs 657-658).

I incorporate that analysis by reference.

(xxxiv) *'905 Patent, [49-c] "one or more fiber collimators serving as one or more add ports for selected spectral channels to be added to said output multi-wavelength optical signal"*

708. I previously analyzed Solgaard in view of the following limitations:

- "fiber collimators serving as . . . one or more other ports . . . ," discussed above in Section IX.1.c.ii (Paragraphs 649-650); and
- "direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.c.xii (Paragraphs 674-675).

I incorporate that analysis by reference.

(xxxv) *'905 Patent, [49-d] "a wavelength-selective device for reflecting said multiple and said selected spectral channels"*

709. I previously analyzed Solgaard in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.c.vi (Paragraphs 659-660).

I incorporate that analysis by reference.

710. A POSITA would recognize that to "separate[] the wavelength channels" and "focus[] [them] onto a corresponding layer . . . of a spatial micromechanical switching matrix, the wavelength-selective device would reflect the wavelength channels. *See* Solgaard at 3:54-

4:1, Fig. 1. Therefore, Solgaard discloses to a POSITA "a wavelength-selective device for reflecting said multiple and said selected spectral channels."

> **(xxxvi)** *'905 Patent, [49-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports and to control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port, whereby said spectral channels from said fiber collimators serving as said add ports are selectively provided to said output port"*

711. I previously analyzed Solgaard in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665); and
- "direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.c.xii (Paragraphs 674-675).

I incorporate that analysis by reference.

> **(xxxvii)** *'905 Patent, [50] "The optical add-drop apparatus of claim 49, wherein none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"*

712. I previously analyzed Solgaard in view of the following limitations:

- "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical

signal are transmitted through a circulator[,]" discussed above in Section IX.1.c.xix (Paragraph 688-689).

I incorporate that analysis by reference.

(xxxviii) *'905 Patent, [51-pre] "A method of performing dynamic add and drop in a WDM optical network, comprising"*

713. I previously analyzed Solgaard in view of the following limitations:

- "[a]n optical add-drop apparatus[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650);
- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.c.xi (Paragraphs 672-673); and
- "the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.c.xii (Paragraphs 674-675).

I incorporate that analysis by reference.

714. To the extent the language in the preamble is considered limiting, a POSITA would understand that the disclosed cross-connect switch in Solgaard would also disclose "[a] method of performing dynamic add and drop in a WDM optical network." Therefore, Solgaard discloses to a POSITA "[a] method of performing dynamic add and drop in a WDM optical network."

(xxxix) *'905 Patent, [51-a] "separating an input multi-wavelength optical signal into spectral channels"*

715. I previously analyzed Solgaard in view of the following similar limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.c.vi (Paragraphs 659-660).

I incorporate that analysis by reference.

(xl) *'905 Patent, [51-b] "imaging each of said spectral channels onto a corresponding beam-deflecting element"*

716. I previously analyzed Solgaard in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channel[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665); and
- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.c.xvi (Paragraph 682-683).

I incorporate that analysis by reference.

(xli) *'905 Patent, [51-c] "controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal"*

717. I previously analyzed Solgaard in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665);

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.c.x (Paragraph 671); and
- "said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal[,]" discussed above in Section IX.1.c.xiv (Paragraphs 679-680).

I incorporate that analysis by reference.

718. A POSITA would understand that the disclosed individually and continuously controllable beam-deflecting elements of Solgaard are dynamically controlled. *See* Solgaard at 4:9-22, 6:57-7:20, Figs. 2, 3. Therefore, Solgaard discloses to a POSITA "controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal."

(xlii) *'905 Patent, [51-d] "receiving the output multi-wavelength optical signal at an output port that transmits the output multi-wavelength optical signal to an optical fiber; and wherein"*

719. I previously analyzed Solgaard in view of the following limitations:

- "an output port[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650);
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.c.v (Paragraphs 657-658); and

- "each of said elements . . . reflect[ing] its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665).

I incorporate that analysis by reference.

720. Solgaard specifically discloses transmitting the output signal "to an output fiber." For example, Solgaard explains that "[t]he spatially reorganized wavelength channels are finally collimated and recombined . . . onto three output fibers." *See id.* at 3:54-4:1; *see also id.* at Abstract, 1:19-23, 1:63-67, 4:9-22, 6:57-7:20, 8:59-66, FIGS. 1-3, 8. Therefore, Solgaard discloses to a POSITA "receiving the output multi-wavelength optical signal at an output port that transmits the output multi-wavelength optical signal to an optical fiber."

(xliii) *'905 Patent, [51-e] "said selected ones of said spectral channels comprises a subset of said spectral channels, such that other non-selected ones of said spectral channels are dropped from said output multi-wavelength optical signal; and"*

721. I previously analyzed Solgaard in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665); and
- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.c.xi (Paragraphs 672-673).

I incorporate that analysis by reference.

(xliv) *'905 Patent, [51-f] "said controlling comprises reflecting said non-selected ones of said spectral channels to one or more fiber collimator serving as drop ports"*

722. I previously analyzed Solgaard in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665); and
- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.c.xi (Paragraphs 672-673).

I incorporate that analysis by reference.

(xlv) *'905 Patent, [52] "The method of claim 51 further comprising imaging other spectral channels onto other corresponding beam-deflecting elements, and controlling dynamically and continuously said other beam-deflecting elements so as to combine said other spectral channels with said selected ones of said spectral channels into said output multi-wavelength optical signal"*

723. I previously analyzed Solgaard in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665);

- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665);
- "direct[ing] selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.c.xii (Paragraphs 674-675); and
- "controlling dynamically . . . beam-deflecting elements[,]" discussed above in Section IX.1.c.xli (Paragraphs 717-718).

I incorporate that analysis by reference.

(xlvi) *'905 Patent, [53] "The method of claim 51, wherein said imaging comprises focusing said spectral channels onto said beam-deflecting elements"*

724. I previously analyzed Solgaard in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665); and
- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.c.xvi (Paragraph 682-683).

I incorporate that analysis by reference.

(xlvii) *'905 Patent, [54] "The method of claim 51 further comprising monitoring a power level in one or more of said selected ones of said spectral channels, and controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring"*

725. I previously analyzed Solgaard in view of the following limitations:

- "a spectral monitor for monitoring said power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.c.x (Paragraph 671).

726. I incorporate that analysis by reference.

(xlviii) *'906 Patent, [68-pre] "A wavelength-separating-routing apparatus, comprising"*

727. To the extent the language in the preamble is considered limiting, Solgaard discloses to a POSITA "[a] wavelength-separating-routing apparatus." For example, Solgaard "relates to ***a cross-connect switch for fiber optic communication networks*** including wavelength division multiplexed (WDM) networks, and more particularly to such an optical switch using a matrix of individually tiltable micro-mirrors." *See id.* at 1:19-23 (emphasis added); *see also id.* at Abstract, 1:63-67, 3:54-4:1, Fig. 1.

728. Therefore, Solgaard discloses to a POSITA "[a] wavelength-separating-routing apparatus."

(xlix) *'906 Patent, [68-a] "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports"*

729. I previously analyzed Solgaard in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650).

I incorporate that analysis by reference.

730. Solgaard further explains that "[t]he spatially reorganized wavelength channels are finally ***collimated*** and recombined onto three output fibers." *See id.* at 3:54-4:1 (emphasis added); *see also id.* at 1:63-67, 8:59-66, Figs. 1, 8. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a

collimator and a port to make a "fiber collimator" port in a single package. Therefore, under Capella's apparent interpretation, Solgaard discloses to a POSITA "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports."

(l) *'906 Patent, [68-b] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

731. I previously analyzed Solgaard in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.c.vi (Paragraphs 659-660).

I incorporate that analysis by reference.

(li) *'906 Patent, [68-c] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

732. I previously analyzed Solgaard in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.c.xvi (Paragraph 682-683).

I incorporate that analysis by reference.

733. Solgaard further explains that "the spot size and the spot separation on the switching matrix 20 can be individually controlled." *See id.* at 4:1-4. Therefore, Solgaard discloses to a POSITA "a beam-focuser, for focusing said spectral channels into corresponding spectral spots."

(lii) *'906 Patent, [68-d] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports"*

734. I previously analyzed Solgaard in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665).

I incorporate that analysis by reference.

735. Solgaard discloses to a POSITA "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports." Further, to the extent Solgaard does not teach continuous control, "being pivotal about two axes," and "to control the power of said received spectral channels," these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Solgaard explains that "[m]irrors of this size, as well as mirrors suitable for larger matrices are easily fabricated by a standard surface micromachining process. This implies that

micromachined switching matrices can be scaled to large numbers of fiber channels (e.g., N=16).” *See id.* at 5:46-50; *see also id.* Abstract, 4:9-22, 6:57-7:20, Figs. 2-3.

736. Therefore, Solgaard discloses to a POSITA “a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors . . . being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports.” Further, to the extent Solgaard does not teach continuous control, “being pivotal about two axes,” and “to control the power of said received spectral channels,” these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(liii) *’906 Patent, [69] “The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports”*

737. I previously analyzed Solgaard in view of the following limitations:

- “a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]” discussed above in Section IX.1.c.x (Paragraph 671); and
- “control coupling efficiency of one of the first and second spectral channel to at least one port[,]” discussed above in Section IX.1.c.xxii (Paragraph 694-695).

I incorporate that analysis by reference.

738. To the extent Solgaard does not teach "a servo-control assembly," this limitation would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(liv)** *'906 Patent, [70] "The wavelength-separating-routing apparatus of claim 69 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

739. I previously analyzed Solgaard in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.c.x (Paragraph 671).

I incorporate that analysis by reference.

740. To the extent Solgaard does not teach "said serv-control assembly[,]" this limitation would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(lv)** *'906 Patent, [71] "The wavelength-separating-routing apparatus of claim 70 wherein said servo-control assembly maintains said power levels at a predetermined value."*

741. To the extent Solgaard does not teach "wherein said servo-control assembly maintains said power levels at a predetermined value[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lvi) *'906 Patent, [72] "The wavelength-separating-routing apparatus of claim 68 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."*

742. I previously analyzed Solgaard in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device[,]"discussed above in Section IX.1.c.xiii (Paragraphs 676-678); and

I incorporate that analysis by reference.

743. Solgaard discloses to a POSITA "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports." Furthermore, Solgaard explains that "six micromirrors . . . are arranged in two arrays . . . that can be individually controlled so as to optically 'couple' any of the three input fibers . . . to any of the three output fibers." *See id.* at 3:54-4:22, Figs. 1-3. A POSITA would understand the micromirrors in Solgaard allow for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device.

744. Therefore, Solgaard discloses to a POSITA "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."

(lvii) *'906 Patent, [79] "The wavelength-separating-routing apparatus of claim 68 wherein each channel micromirror is a silicon micromachined mirror."*

745. Solgaard discloses to a POSITA "wherein each channel micromirror is a silicon micromachined mirror." For example, Solgaard explains that "[m]irrors of this size, as well as mirrors suitable for larger matrices are easily fabricated by a standard surface micromachining process. This implies that micromachined switching matrices can be scaled to large numbers of fiber channels (e.g., N=16)." *See id.* at 5:46-50; *see also id.* at 2:5-14, 4:9-22. Solgaard further explains that the mirror arrays can be "fabricated using ***polysilicon*** surface micromachining technology." *See id.* at 2:8-10 (emphasis added).

746. Therefore, Solgaard discloses to a POSITA "wherein each channel micromirror is a silicon micromachined mirror."

(lviii) *'906 Patent, [80] "The wavelength-separating-routing apparatus of claim 68 wherein said fiber collimator input and output ports are arranged in a one-dimensional array."*

747. I previously analyzed Solgaard in view of the following limitations:

- "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array[,]"discussed above in Section IX.1.c.xx (Paragraph 690-691).

I incorporate that analysis by reference.

(lix) *'906 Patent, [81] "The wavelength-separating-routing apparatus of claim 68 wherein said beam-focuser comprises a focusing lens having first and second focal points."*

748. Solgaard discloses to a POSITA "wherein said beam-focuser comprises a focusing lens having first and second focal points." For example, Solgaard explains that "input and output lens systems are each composed of a lenslet array 26 (32) and a pair of bulk lenses 28, 30 (34, 36) such that the spot size and the spot separation on the switching matrix 20 can be

individually controlled." *See* Solgaard at 3:54-4:4, Figs. 1, 8. Figure 1 illustrates the first and second focal points of these lenses.

749. Therefore, Solgaard discloses to a POSITA "wherein said beam-focuser comprises a focusing lens having first and second focal points."

> **(lx)** *'906 Patent, [82] "The wavelength-separating-routing apparatus of claim 81 wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens."*

750. To the extent Solgaard does not teach "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(lxi)** *'906 Patent, [83] "The wavelength-separating-routing apparatus of claim 68 wherein said beam-focuser comprises an assembly of lenses."*

751. Solgaard discloses to a POSITA "wherein said beam-focuser comprises an assembly of lenses." For example, Solgaard explains that "[t]he input and output lens systems are each composed of ***a lenslet array 26 (32) and a pair of bulk lenses 28, 30 (34,36)*** such that the spot size and the spot separation on the switching matrix 20 can be individually controlled." *See* Solgaard at 3:54-4:4, Fig. 1 (emphasis added). This arrangement is depicted in Figure 1 below.

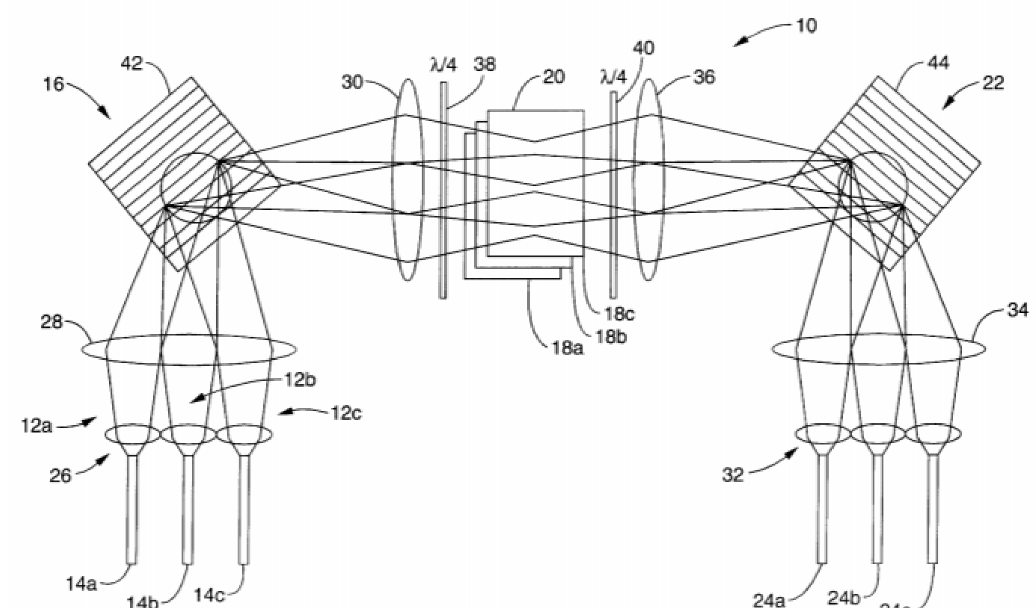


FIG. 1

752. Therefore, Solgaard discloses to a POSITA "wherein said beam-focuser comprises an assembly of lenses."

> **(lxii)** *'906 Patent, [84] "The wavelength-separating-routing apparatus of claim 68 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing gratings."*

753. I previously analyzed Solgaard in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.c.xvii (Paragraph 684-685).

I incorporate that analysis by reference.

(lxiii) *'906 Patent, [85] "The wavelength-separating-routing apparatus of claim 68 further comprising a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors."*

754. Solgaard discloses to a POSITA "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors." For example, Solgaard explains that "***[t]wo quarter-wave plates 38, 40 are inserted symmetrically around the micromechanical switching matrix 20*** to compensate for the polarization sensitivity of the gratings 42, 44, respectively." *See* Solgaard at 4:5-8, Fig. 1 (emphasis added). This arrangement is depicted in Figure 1 below.

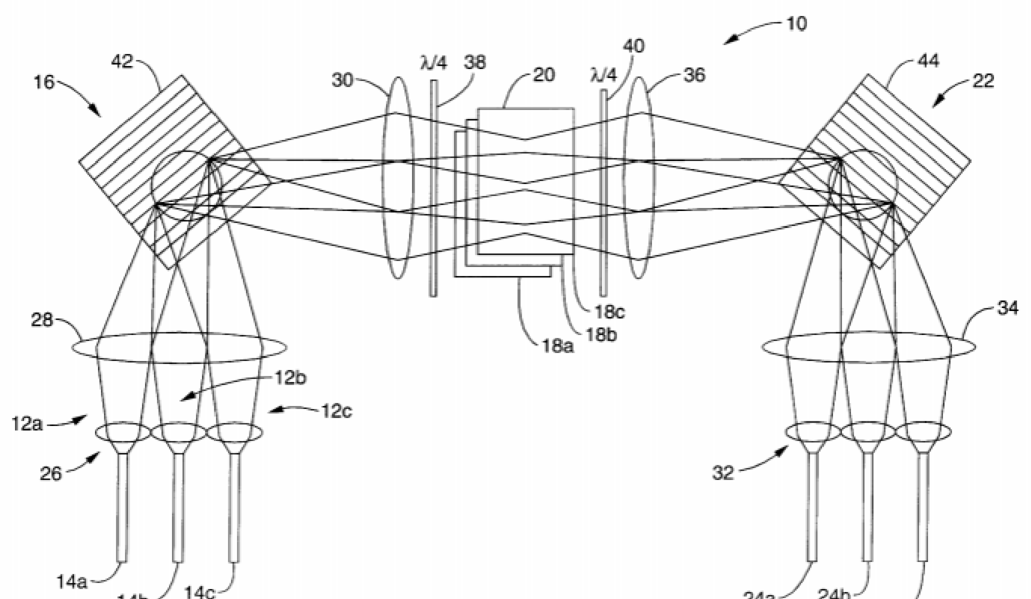


FIG. 1

755. Furthermore, Solgaard explains that "***[a] quarter-wave plate 76 is inserted symmetrically around the switching array 74*** to compensate for the polarization sensitivity of the gratings 70." *See id.* at 9:3-5, Fig. 8 (emphasis added). This arrangement is depicted in Figure 8 below.

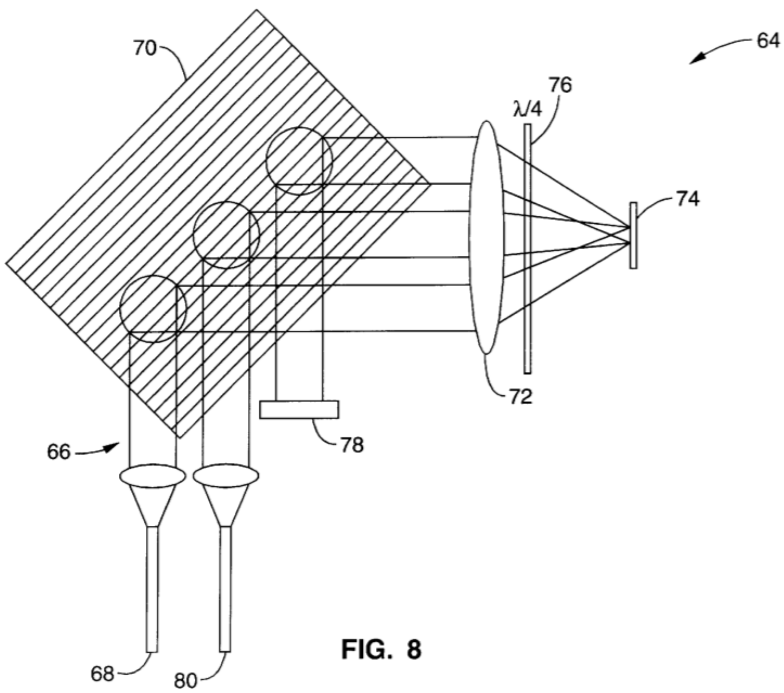


FIG. 8

756. Therefore, Solgaard discloses to a POSITA "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors."

(lxiv) *'906 Patent, [86] "The wavelength-separating-routing apparatus of claim 68 wherein each fiber collimator output port carries a single one of said spectral channels."*

757. To the extent Solgaard does not teach "wherein each fiber collimator output port carries a single one of said spectral channels[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxv) *'906 Patent, [87] "The wavelength-separating-routing apparatus of claim 86 further comprising one or more optical sensors, optically coupled to said fiber collimator output ports."*

758. To the extent Solgaard does not teach "one or more optical sensors, optically coupled to said fiber collimator output ports[,]" these limitations would have been within the

common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxvi) *'906 Patent, [88] "The wavelength-separating-routing apparatus of claim 68, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator."*

759. I previously analyzed Solgaard in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.c.xix (Paragraph 688-689).

I incorporate that analysis by reference.

(lxvii) *'906 Patent, [89-pre] "A servo-based optical apparatus comprising"*

760. I previously analyzed Solgaard in view of the following limitations:

- "An optical . . . apparatus[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665); and
- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.c.x (Paragraph 671).

I incorporate that analysis by reference.

(lxviii) *'906 Patent, [89-a] "multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports"*

761. I previously analyzed Solgaard in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650); and
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.c.xlix (Paragraphs 729-730).

I incorporate that analysis by reference.

(lxix) *'906 Patent, [89-b] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

762. I previously analyzed Solgaard in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.c.vi (Paragraphs 659-660).

I incorporate that analysis by reference.

(lxx) *'906 Patent, [89-c] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

763. I previously analyzed Solgaard in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.c.xvi (Paragraph 682-683); and
- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.c.li (Paragraphs 732-733).

I incorporate that analysis by reference.

(lxxi) *'906 Patent, [89-d] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said fiber collimator output ports"*

764. I previously analyzed Solgaard in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.c.lii (Paragraphs 734-736).

I incorporate that analysis by reference.

(lxxii) *'906 Patent, [89-e] "a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports."*

765. I previously analyzed Solgaard in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.c.x (Paragraph 671); and
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.c.xxii (Paragraph 694-695).

I incorporate that analysis by reference.

766. To the extent Solgaard does not teach "a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxiii) *'906 Patent, [90] "The servo-based optical apparatus of claim 89 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

767. I previously analyzed Solgaard in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.c.x (Paragraph 671).

I incorporate that analysis by reference.

768. To the extent Solgaard does not teach "said servo-control assembly[,]" this limitation would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxiv) *'906 Patent, [91] "The servo-based optical apparatus of claim 90 wherein said servo-control assembly maintains said power levels at a predetermined value"*

769. To the extent Solgaard does not teach "wherein said servo-control assembly maintains said power levels at a predetermined value[,]" these limitations would have been

within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxv) *'906 Patent, [92] "The servo-based optical apparatus of claim 89 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."*

770. I previously analyzed Solgaard in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device[,]"discussed above in Section IX.1.c.xiii (Paragraphs 676-678); and
- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.c.lvi (Paragraphs 742-744).

I incorporate that analysis by reference.

(lxxvi) *'906 Patent, [96] "The servo-based optical apparatus of claim 89 wherein each channel micromirror is a silicon micromachined mirror."*

771. I previously analyzed Solgaard in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.c.lvii (Paragraphs 745-746).

I incorporate that analysis by reference.

(lxxvii) *’906 Patent, [97] “The servo-based optical apparatus of claim 89 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms.”*

772. I previously analyzed Solgaard in view of the following limitations:

- “wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]”discussed above in Section IX.1.c.xvii (Paragraph 684-685).

I incorporate that analysis by reference.

(lxxviii) *’906 Patent, [98] “The servo-based optical apparatus of claim 89 wherein said beam-focuser comprises one or more lenses.”*

773. I previously analyzed Solgaard in view of the following limitations:

- “wherein said beam-focuser comprises an assembly of lenses[,]”discussed above in Section IX.1.c.lxi (Paragraphs 751-752).

I incorporate that analysis by reference.

(lxxix) *’906 Patent, [99] “The servo-based optical apparatus of claim 89, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator”*

774. I previously analyzed Solgaard in view of the following limitations:

- “wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]”discussed above in Section IX.1.c.xix (Paragraph 688-689).

I incorporate that analysis by reference.

(lxxx) *'906 Patent, [100-pre] "An optical apparatus comprising:"*

775. I previously analyzed Solgaard in view of the following limitations:

- "An optical . . . apparatus[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650).

I incorporate that analysis by reference.

(lxxxi) *'906 Patent, [100-a] "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal"*

776. I previously analyzed Solgaard in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650); and
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.c.xlix (Paragraphs 729-730).

I incorporate that analysis by reference.

777. Under Capella's apparent interpretation, Solgaard discloses to a POSITA "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal." Solgaard explains that "[t]he input fiber 68 and output fiber 80 can be arranged in, a variety of ways. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package. For example, they can be arranged ***side by side in the plane*** as shown in FIG.8." *See id.* at 9:13-19, Fig. 8 (emphasis added).

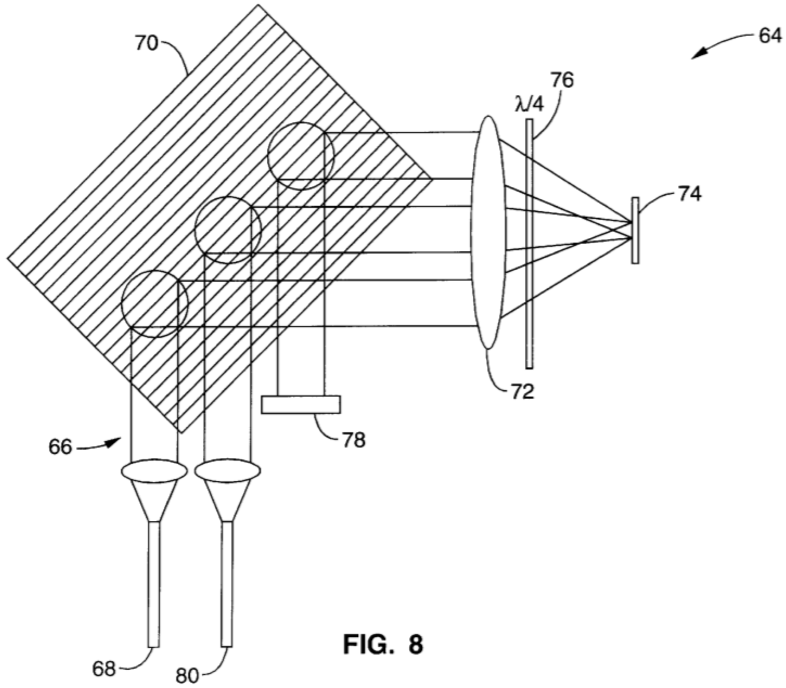


FIG. 8

778. Therefore, under Capella's apparent interpretation, Solgaard discloses to a POSITA "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal."

(lxxxii) *'906 Patent, [100-b] "a plurality of output ports"*

779. I previously analyzed Solgaard in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650).

I incorporate that analysis by reference.

(lxxxiii) *'906 Patent, [100-c] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

780. I previously analyzed Solgaard in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.c.vi (Paragraphs 659-660).

I incorporate that analysis by reference.

(lxxxiv) *’906 Patent, [100-d] “a beam-focuser, for focusing said spectral channels into corresponding spectral spots”*

781. I previously analyzed Solgaard in view of the following limitations:

- “a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]” discussed above in Section IX.1.c.xvi (Paragraph 682-683); and
- “a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]” discussed above in Section IX.1.c.li (Paragraphs 732-733).

I incorporate that analysis by reference.

(lxxxv) *’906 Patent, [100-e] “a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually and continuously controllable to reflect said spectral channels into selected ones of said output ports”*

782. I previously analyzed Solgaard in view of the following limitations:

- “a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]” discussed above in Section IX.1.c.vii (Paragraphs 661-665); and
- “a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports

and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.c.lii (Paragraphs 734-736).

I incorporate that analysis by reference.

(lxxxvi) *'906 Patent, [100-f] "a one-dimensional array of collimator-alignment mirrors, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports"*

783. I previously analyzed Solgaard in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device[,]"discussed above in Section IX.1.c.xiii (Paragraphs 676-678); and
- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.c.lvi (Paragraphs 742-744).

I incorporate that analysis by reference.

784. To the extent Solgaard does not teach "a one-dimensional array of collimator-alignment mirrors," these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxxvii) *'906 Patent, [106] "The optical apparatus of claim 100, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"*

785. I previously analyzed Solgaard in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.c.xix (Paragraph 688-689).

I incorporate that analysis by reference.

(lxxxviii) *'906 Patent, [115-pre] "An optical system comprising a wavelength-separating-routing apparatus, wherein said wavelength-separating-routing apparatus includes"*

786. I previously analyzed Solgaard in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]" discussed above in Section IX.1.c.xlviii (Paragraphs 727-728).

I incorporate that analysis by reference.

787. To the extent the language in the preamble is considered limiting, a POSITA would understand that the disclosed cross-connect switch in Solgaard would also disclose "[a]n optical system comprising a wavelength-separating-routing apparatus." Therefore, Solgaard discloses to a POSITA "[a]n optical system comprising a wavelength-separating-routing apparatus."

(lxxxix) *'906 Patent, [115-a] "an array of fiber collimators, providing and serving as an input port for a multi-wavelength optical signal"*

788. I previously analyzed Solgaard in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650);
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.c.xlix (Paragraphs 729-730); and

- "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal[,]" discussed above in Section IX.1.c.lxxxi (Paragraphs 776-779).

I incorporate that analysis by reference.

(xc) *'906 Patent, [115-b] "a plurality of output ports including a pass-through port and one or more drop ports"*

789. I previously analyzed Solgaard in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650).

I incorporate that analysis by reference.

790. To the extent Solgaard does not teach "a pass-through port and one or more drop ports," these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xci) *'906 Patent, [115-c] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

791. I previously analyzed Solgaard in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.c.vi (Paragraphs 659-660).

I incorporate that analysis by reference.

(xcii) *'906 Patent, [115-d] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

792. I previously analyzed Solgaard in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.c.xvi (Paragraph 682-683); and

- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.c.li (Paragraphs 732-733).

I incorporate that analysis by reference.

(xciii) *'906 Patent, [115-e] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels."*

793. I previously analyzed Solgaard in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.c.lii (Paragraphs 734-736).

I incorporate that analysis by reference.

794. To the extent Solgaard does not teach "whereby said fiber collimator pass-through port receives a subset of said spectral channels," this limitation would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xciv) *'906 Patent, [116] "The optical system of claim 115 further comprising a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports"*

795. I previously analyzed Solgaard in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.c.x (Paragraph 671); and
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.c.xxii (Paragraph 694-695).

I incorporate that analysis by reference.

796. To the extent Solgaard does not teach "a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xcv) *'906 Patent, [117] "The optical system of claim 116 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

797. I previously analyzed Solgaard in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.c.x (Paragraph 671).

I incorporate that analysis by reference.

798. To the extent Solgaard does not teach "said servo-control assembly [,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xcvi) *'906 Patent, [118] "The optical system of claim 115 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimators, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports."*

799. I previously analyzed Solgaard in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device[,]"discussed above in Section IX.1.c.xiii (Paragraphs 676-678); and
- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port

and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.c.lvi (Paragraphs 742-744).

I incorporate that analysis by reference.

(xcvii) *'906 Patent, [122] "The optical system of claim 115 wherein each channel micromirror is a silicon micromachined mirror."*

800. I previously analyzed Solgaard in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.c.lvii (Paragraphs 745-746).

I incorporate that analysis by reference.

(xcviii) *'906 Patent, [123] "The optical system of claim 115 wherein said beam-focuser comprises a focusing lens having first and second focal points, and wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points"*

801. I previously analyzed Solgaard in view of the following limitations:

- "wherein said beam-focuser comprises a focusing lens having first and second focal points[,]"discussed above in Section IX.1.c.lix (Paragraphs 748-749).

I incorporate that analysis by reference.

802. To the extent Solgaard does not teach "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points[,]" this limitation would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xcix) *'906 Patent, [124] "The optical system of claim 115 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

803. I previously analyzed Solgaard in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.c.xvii (Paragraph 684-685).

I incorporate that analysis by reference.

(c) *'906 Patent, [125] "The optical system of claim 115 further comprising a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors"*

804. I previously analyzed Solgaard in view of the following limitations:

- "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors[,]"discussed above in Section IX.1.c.lxiii (Paragraphs 754-756).

I incorporate that analysis by reference.

(ci) *'906 Patent, [126-pre] "The optical system of claim 115 further comprising an auxiliary wavelength-separating-routing apparatus, including:"*

805. I previously analyzed Solgaard in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]"discussed above in Section IX.1.c.xlviii (Paragraphs 727-728); and
- "An optical system comprising a wavelength-separating-routing apparatus, wherein said wavelength-separating-routing apparatus includes[,]" discussed above in Section IX.1.c.lxxxviii (Paragraphs 786-787).

I incorporate that analysis by reference.

806. To the extent the language in the preamble is considered limiting, a POSITA would understand that the disclosed wavelength-separating-routing apparatus in Solgaard could also be used as "an auxiliary wavelength-separating-routing apparatus." Therefore, Solgaard discloses to a POSITA "an auxiliary wavelength-separating-routing apparatus."

(cii) *'906 Patent, [126-a] "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports"*

807. I previously analyzed Solgaard in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650);
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.c.xlix (Paragraphs 729-730);
- "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal[,]" discussed above in Section IX.1.c.lxxxi (Paragraphs 776-779); and
- "an array of fiber collimators, providing and serving as an input port for a multi-wavelength optical signal[,]" discussed above in Section IX.1.c.lxxxix (Paragraph 788).

I incorporate that analysis by reference.

808. A POSITA would understand that the disclosed fiber collimators in Solgaard could be used as "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports."

(ciii) *'906 Patent, [126-b] "an exiting port"*

809. I previously analyzed Solgaard in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650).

I incorporate that analysis by reference.

810. A POSITA would understand that "an exiting port" is "an output port." Therefore, Solgaard discloses to a POSITA "an exiting port."

(civ) *'906 Patent, [126-c] "an auxiliary wavelength-separator"*

811. I previously analyzed Solgaard in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.c.vi (Paragraphs 659-660).

I incorporate that analysis by reference.

812. A POSITA would understand that the disclosed wavelength-separator in Solgaard could be used as "an auxiliary wavelength-separator."

(cv) *'906 Patent, [126-d] "an auxiliary beam-focuser"*

813. I previously analyzed Solgaard in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.c.xvi (Paragraph 682-683); and
- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.c.li (Paragraphs 732-733).

I incorporate that analysis by reference.

814. A POSITA would understand that the disclosed beam-focuser in Solgaard could be used as "an auxiliary beam-focuser."

(cvi) *'906 Patent, [126-e] "a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors"*

815. I previously analyzed Solgaard in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665);
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.c.lii (Paragraphs 734-736); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said

fiber collimator pass-through port receives a subset of said spectral channels[,]" discussed in Section IX.1.c.xciii (Paragraphs 793-794).

I incorporate that analysis by reference.

816. A POSITA would understand that the disclosed spatial array of channel micromirrors in Solgaard could be used as "a spatial array of auxiliary channel micromirrors."

(cvii) *'906 Patent, [127] "The optical system of claim 126 wherein said auxiliary channel micromirrors are individually pivotable."*

817. Solgaard discloses to a POSITA "wherein said auxiliary channel micromirrors are individually pivotable." Solgaard "us[es] two-dimensional arrays of micromachined, electrically actuated, ***individually-tiltable***, controlled deflection micro-mirrors for providing multiport switching capability for a plurality of wavelengths." *See id.* at Abstract (emphasis added). Solgaard explains that its micromirrors "can be individually controlled" *See id.* at 4:9-22, Fig. 2.

818. Figure 3, reproduced below, depicts "an example of the structural configuration of a row of individually tiltable micromirrors on the switch array." *See id.* at 4:9-22, Fig. 3; *see also id.* at 6:57-7:20.

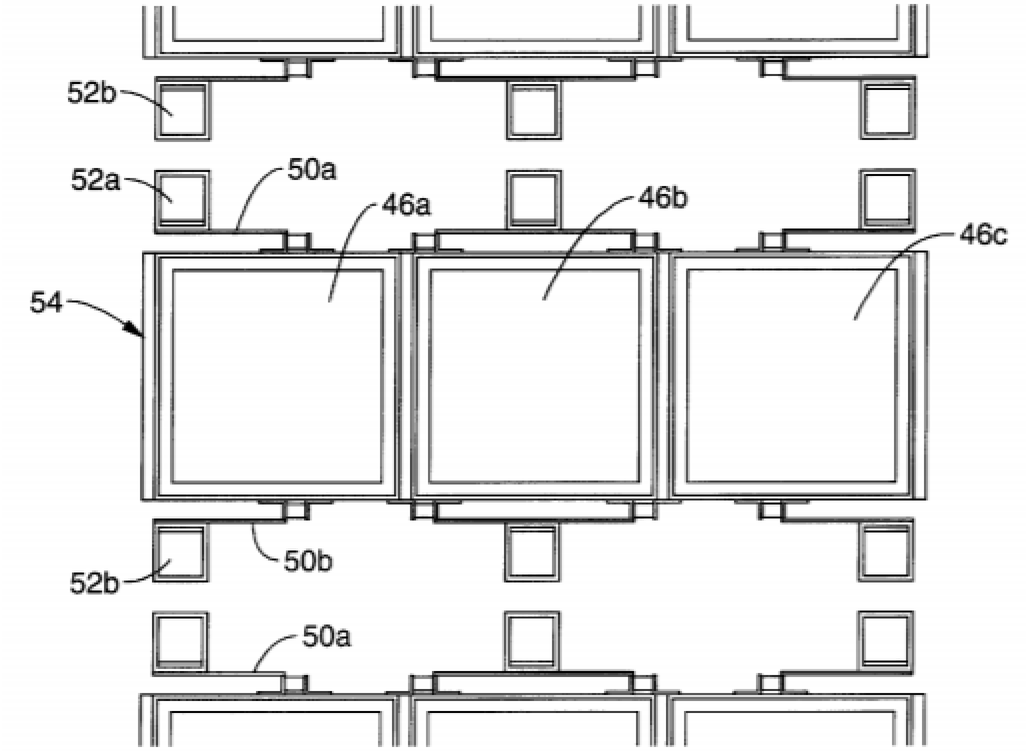


FIG. 3

819. Therefore, Solgaard discloses to a POSITA "wherein said auxiliary channel micromirrors are individually pivotable."

(cviii) *'906 Patent, [129] "The optical system of claim 126 wherein each auxiliary channel micromirror is a silicon micromachined mirror"*

820. I previously analyzed Solgaard in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.c.lvii (Paragraphs 745-746).

I incorporate that analysis by reference.

(cix) *'906 Patent, [130] "The optical system of claim 126 wherein said auxiliary wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

821. I previously analyzed Solgaard in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.c.xvii (Paragraph 684-685).

I incorporate that analysis by reference.

(cx) *'906 Patent, [131] "The optical system of claim 126 wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports."*

822. To the extent Solgaard does not teach "wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cxi) *'906 Patent, [132] "The optical system of claim 115, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator."*

823. I previously analyzed Solgaard in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.c.xix (Paragraph 688-689).

I incorporate that analysis by reference.

(cxii) *'906 Patent, [133] "A method of performing dynamic wavelength separating and routing, comprising"*

824. I previously analyzed Solgaard in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]"discussed above in Section IX.1.c.xlviii (Paragraphs 727-728).

I incorporate that analysis by reference.

825. To the extent the language in the preamble is considered limiting, a POSITA would understand that the disclosed cross-connect switch in Solgaard would also disclose "[a] method of performing dynamic wavelength separating and routing." Therefore, Solgaard discloses to a POSITA "[a] method of performing dynamic wavelength separating and routing."

(cxiii) *'906 Patent, [133-a] "receiving a multi-wavelength optical signal from a fiber collimator input port"*

826. I previously analyzed Solgaard in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.c.ii (Paragraphs 649-650); and
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.c.xlix (Paragraphs 729-730).

I incorporate that analysis by reference.

(cxiv) *'906 Patent, [133-b] "separating said multi-wavelength optical signal into multiple spectral channels"*

827. I previously analyzed Solgaard in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.c.vi (Paragraphs 659-660).

I incorporate that analysis by reference.

(cxv) *'906 Patent, [133-c] "focusing said spectral channels onto a spatial array of corresponding beam-deflecting elements, whereby each beam-deflecting element receives one of said spectral channels"*

828. I previously analyzed Solgaard in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.c.xvi (Paragraph 682-683); and
- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels," discussed above in Section IX.1.c.vii (Paragraphs 661-665).

I incorporate that analysis by reference.

(cxvi) *'906 Patent, [133-d] "dynamically and continuously controlling said beam-deflecting elements in two dimensions to direct said spectral channels into any selected ones of output ports and to control the power of the spectral channels coupled into said selected output ports"*

829. I previously analyzed Solgaard in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665);
- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.c.x (Paragraph 671); and

- "said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal[,]" discussed above in Section IX.1.c.xiv (Paragraphs 679-680);
- "controlling dynamically and continuously said beam-deflecting elements in two dimensions[,]"discussed above in Section IX.1.c.xli (Paragraphs 717-718);
- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.c.lii (Paragraphs 734-736).

I incorporate that analysis by reference.

(cxvii) *'906 Patent, [134] "The method of claim 133 further comprising the step of providing feedback control of said beam-deflecting elements to maintain a predetermining coupling of each spectral channel directed into one of said output ports."*

830. I previously analyzed Solgaard in view of the following limitations:

- "a spatial array of beam-deflecting elements[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665);
- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.c.x (Paragraph 671); and
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.c.xxii (Paragraph 694-695).

I incorporate that analysis by reference.

(cxviii) *'906 Patent, [135] "The method of claim 134 further comprising the step of maintaining power levels of said spectral channels directed into said output ports at a predetermining value."*

831. I previously analyzed Solgaard in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.c.x (Paragraph 671).

I incorporate that analysis by reference.

832. To the extent Solgaard does not teach "the step of maintaining power levels of said spectral channels directed into said output ports at a predetermining value[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cxix) *'906 Patent, [137] "The method of claim 133 wherein a subset of said spectral channels is directed into one of said output ports, thereby providing one or more pass-through spectral channels."*

833. I previously analyzed Solgaard in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.c.vii (Paragraphs 661-665);
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.c.lii (Paragraphs 734-736); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels[,]"discussed above in Section IX.1.c.xciii (Paragraphs 793-794).

I incorporate that analysis by reference.

> **(cxx)** *'906 Patent, [138] "The method of claim 137 further comprising the step of multiplexing said pass-through spectral channels with one or more add spectral channels, so as to provide an output optical signal."*

834. I previously analyzed Solgaard in view of the following limitations:

- "wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors[,]"discussed above in Section IX.1.c.cvi (Paragraphs 815-816).

I incorporate that analysis by reference.

> **(cxxi)** *'906 Patent, [139] "The method of claim 133 wherein said beam-deflecting elements comprise an array of silicon micromachined mirrors."*

835. I previously analyzed Solgaard in view of the following limitations:

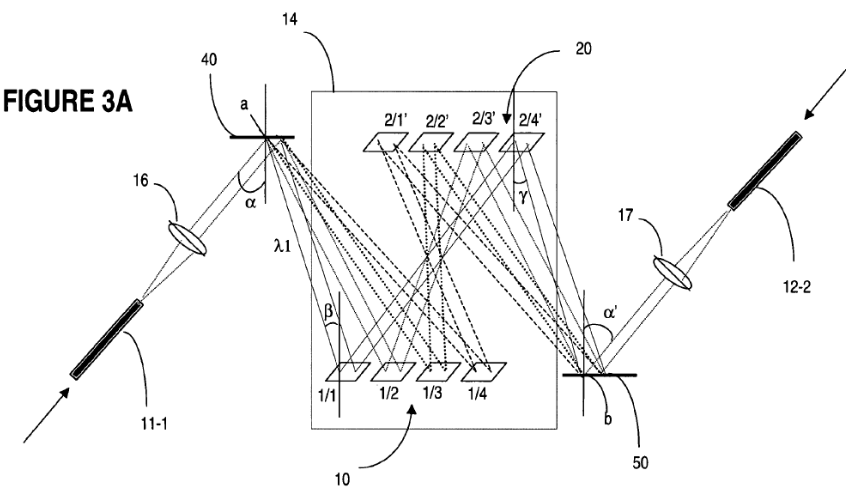
- "a spatial array of beam-deflecting elements[,]"discussed above in Section IX.1.c.vii (Paragraphs 661-665);
- "a spatial array of channel micromirrors[,] discussed above in Section IX.1.c.lii (Paragraphs 734-736); and
- "wherein each channel micromirror is a silicon micromachined mirror[,]" discussed above in Section IX.1.c.lvii (Paragraphs 745-746).

I incorporate that analysis by reference.

d) U.S. Patent No. 7,106,966 ("Lalonde ")

836. Lalonde is directed to "[an] integrated photonic switch [that] can be used in all-optical networks." *See* Lalonde at Abstract. Lalonde states that "incoming multiplexed signals from a number of input fiber ports are separated into their component wavelengths. . . . Individual wavelengths are switched within the switch fabric towards the desired output, and the wavelengths are then multiplexed into WDM signals directed to the appropriate output ports." *See id.* As shown in Figure 3A, reproduced below, the switch input ports (*e.g.*, reference numeral 11-1), a collimating lens (reference numeral 16), a diffraction grating (reference numerals 40 and 50), a 3-D MEMs device (reference numerals 10 and 20), a focusing lens (reference numeral 17), and switch output ports (*e.g.*, reference numeral 12-2).

FIGURE 3A



(i) *Lalonde Is Prior Art to the Asserted Claims*

837. Lalonde claims priority to CA2,300,780, filed on March 15, 2000, and its application was filed on June 1, 2000 and issued on September 12, 2006. Accordingly, Lalonde is prior art to the '905 and '906 Patents under at least pre-AIA 35 U.S.C. § 102(e).

838. I have reviewed the transcript of the deposition of Alan Solheim, a named inventor of Lalonde. I incorporate that deposition transcript into my analysis herein. For

example, Mr. Solheim testified that the switch described in Lalonde eliminated the need for electrical components in optical switching:

> Q And, at a high level, what is the invention disclosed in this patent?
>
> A This is a device for switching wavelengths between input fibers and output fibers without the need to demultiplex down to electrical level. So it separates the wavelengths, these DWDM wavelengths that we talked about earlier, into -- separates them out, and then it allows the switching device to switch them between a given input fiber and a selection of output fibers so you can rearrange the wavelengths on the ingress, incoming and outcoming fiber streams.
>
> * * *
>
> Q And why was it important to eliminate electrical to optical to electrical conversion?
>
> A Primarily for cost, but also for power and space. For example, the -- in the Figure 1, the -- the box in table -- inside -- the equipment inside box C would have been several racks of equipment probably, you know, two to four, 20 -- 23 entracks of equipment, so, you know -- which are six or seven feet tall, so, you know, several -- several square feet, you know, 10s of square feet of equipment, you know, reaching from floor to ceiling, dissipating 100s, if not 1000s, of watts of power. And the associated cost with all that, the transponders are expensive devices. Whereas the switch in box C in Figure 2 is an optical component that could, you know, almost fit in the palm of your hand, dissipates relatively little power, and provides, you know, a much higher capacity throughput. I guess the other thing, the switch -- switch fabric in Figure 1 is limited -- limited to the size of the electrical fabric, and the switching capability in Figure 2 is limited to the number of wavelengths that can be packed into the fibers, so it can be 10s or 100s of times higher capacity than the -- the previous system. So lower cost, lower footprint, lower power, higher capacity are the fundamental benefits.

Id. at 18:24–19:10, 25:18–26:20.

839. Mr. Solheim also testified that various passive optical components could be incorporated into optical switches and a POSITA would have known how to position such components:

> Q And what is a passive optical element?
>
> A Pardon me. A passive optical element is a device such as a mirror or a lens or a fiber that does not the require electrical power for its function.

> An active optical device would be something like a laser or a light emitting diode that does require electricity for -- for -- for its function.
>
> Q And is a focusing lens an example of a passive optical element?
>
> MR. BECKER: Object. Form.
>
> THE WITNESS: Yes, it is.
>
> BY MR. GAUSTAD: Q And is a collimating lens an example of a passive optical element?
>
> MR. BECKER: Object. Form.
>
> THE WITNESS: Yes, it is.
>
> BY MR. GAUSTAD: Q Is a quarter wave plate an example of a passive optical element?
>
> MR. BECKER: Object. Form.
>
> THE WITNESS: Yes, it is.
>
> * * *
>
> Q And was it common knowledge in 2000 to position optical elements at focal points?
>
> MR. BECKER: Object. Form.
>
> THE WITNESS: Yes, I mean, that's been standard optics for -- since before I started optics.

Id. at 51:16–52:13, 54:2–6.

(ii) *'905 Patent, [23-pre]: "An optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports, the apparatus comprising"*

840. Lalonde discloses to a POSITA "[a]n optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports." As shown in Figure 1 below, switch nodes C and D each provide "an optical add/drop multiplexer (OADM) 3[, 3'] for effecting add/drop operations." *See id.* at 4:5-11, Fig. 1. The optical

add/drop multiplexer "separates the traffic addressed to a local user (drop operation) and adds local traffic at the output of the switch, for a remote user (add operation)." *See id.*

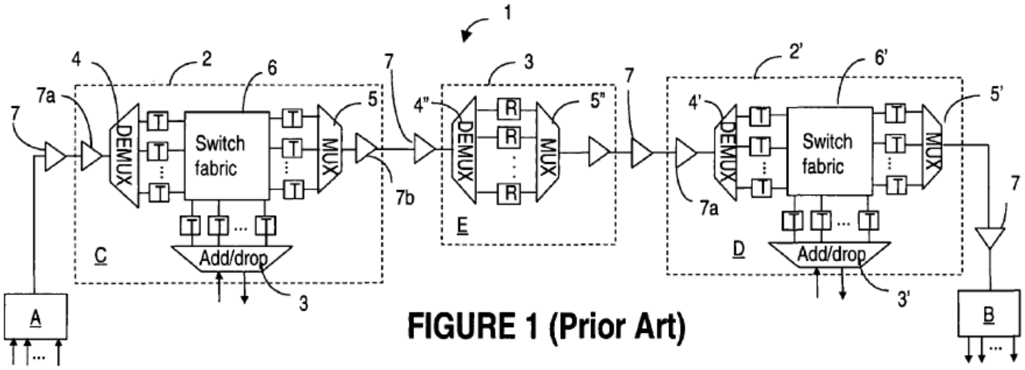


FIGURE 1 (Prior Art)

841. As shown in Figure 2 below, "[s]witching block 8, 8′ [controls] the path of the wavelengths within the switch fabric from the input ports (connectors) to the output ports, by adequately orienting the 3D-MEMS devices." *See id.* at 4:61-64, Fig. 2; *see also id.* at 4:46-51, 5:23-28.

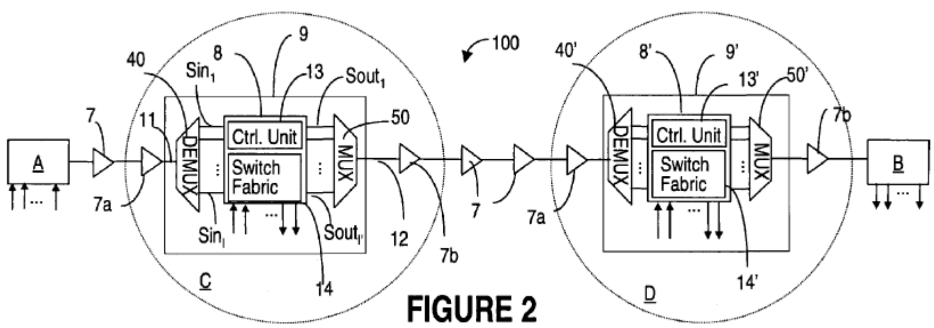
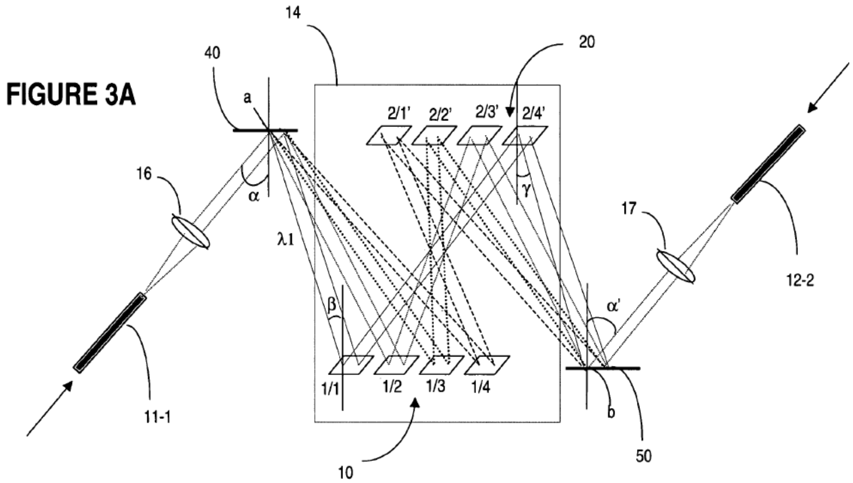
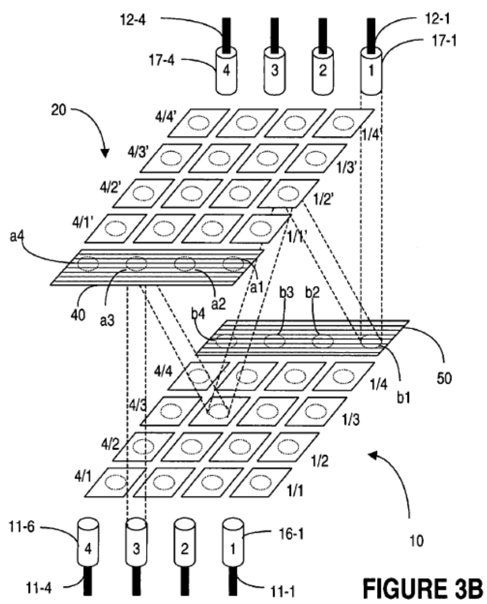


FIGURE 2

842. Figure 3A, reproduced below, illustrates "how the wavelengths are demultiplexed at the input side of the switch and multiplexed at the output side." *See id.* at 5:34-40, Fig. 3A. "[Input] [f]iber 11-1 . . . is aligned to direct the incoming light on collimating lens 16." *See id.* at 5:67-6:4, Fig. 3A; *see also id.* at 6:42-44.

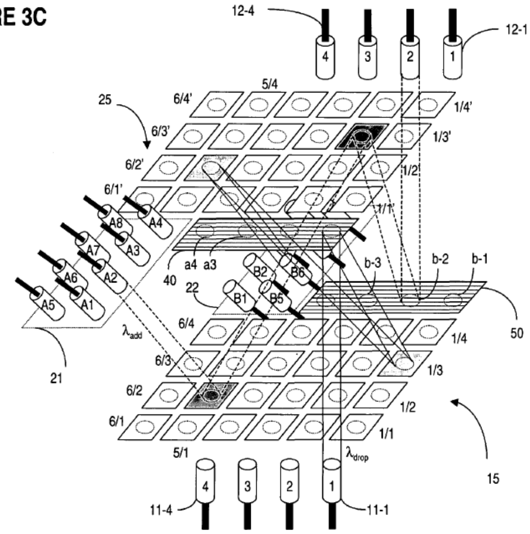


843. Furthermore, Figure 3B, reproduced below, "shows a perspective view of a switch fabric with 3-D MEMS matrices 10 and 20, for switching 4-channel signals input on four fibers 11-1 to 11-4 to output fibers 12-1 to 12-4. The control unit, the focusing lens and collimating lens are not illustrated, for simplification." *See id.* at 7:8-12, Fig. 3B.



844. Similarly, Figure 3C, reproduced below, "shows a spatial view of a photonic switch 9 with integrated add/drop, and examples of add and drop operations." *See id.* at 7:47-52, Fig. 3C; *see also id.* at 7:52-59.

FIGURE 3C



845. Therefore, Lalonde discloses to a POSITA "[a]n optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports."

(iii) *'905 Patent, [23-a] "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels"*

846. Lalonde discloses to a POSITA "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels." For example, Lalonde explains that "[t]he input span 11 and output span 12 in FIG. 2 comprise ***a plurality of input and output fibers and the associated ports***, each carrying a respective multi-channel (DWDM) input/output optical signal." *See id.* at 4:65-5:13 (emphasis added). Lalonde further notes that "the maximum number of channels (wavelengths) on an input port with K, the maximum number of channels (wavelengths) on an output port with K′ the range of an input channel on a port with k, and the range of an output channel on a port with k′. In this way, an input multichannel signal is denoted with Sin(k,i) and an output multichannel signal is denoted with Sout(k′,i′)." *See id.* Figure 2 is reproduced below.

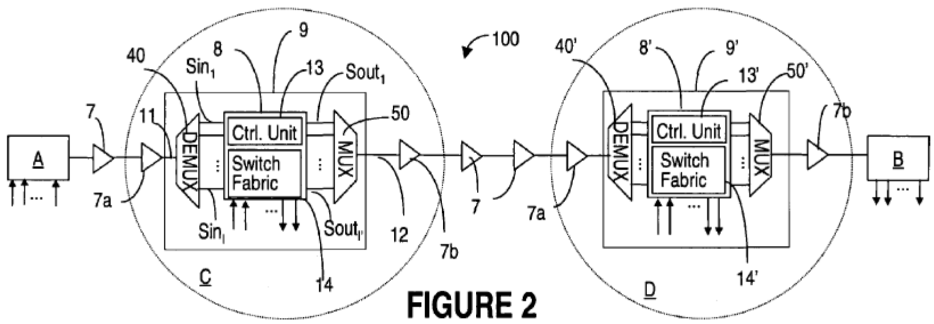
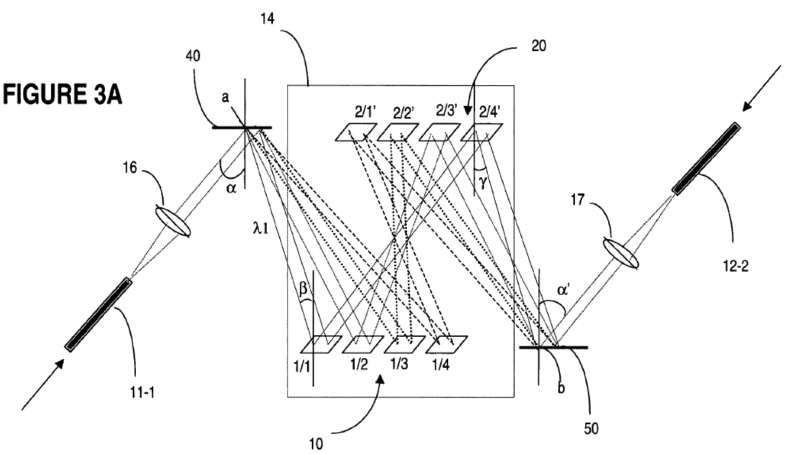


FIGURE 2

847. Furthermore, and as shown in Figures 3A and 3B, reproduced below, "the switch operates according to a wavelength map which results in moving some wavelengths from an input multichannel signal to an output multichannel signal, so that the wavelengths are grouped (multiplexed) differently in the input and output signals." *See* 5:44-49. Figure 3B further shows that each input port includes a collimating lens. Therefore, a POSITA would understand the input ports in Lalonde to be fiber collimator ports.

FIGURE 3A



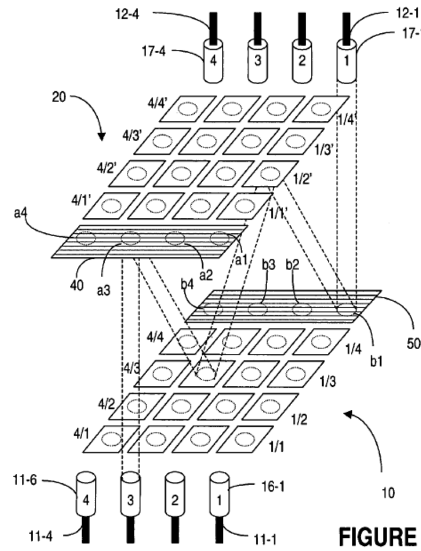


FIGURE 3B

848. Lalonde further explains that "[a]s light from the input fiber 11-1 hits grating 40, it is split into its component wavelengths." *See id.* at 6:54-55. In Lalonde, "[t]he demultiplexer 40 receives the input DWDM signals from the input fibers and separates each DWDM signal into component channels (wavelengths). Thus, the multichannel signal Sin(4,1) from fiber 11-1 is directed on spot a1, the multichannel signal Sin(4,2) from fiber 11-2 is directed on spot a2, etc. A channel λ_k of Sin(k,i) is directed on a first 3-D MEMS mirror k/i of the first matrix 10, according to the port (i) on which it arrives at the switch, and the position of spot a and the wavelength λ_k. In FIG. 3B, wavelength λ3 arriving to the photonic switch 9 over fiber 11-3 is directed by diffraction grating 40 from spot a3 onto first mirror 3/3." *See id.* at 7:23-33.

849. Therefore, Lalonde discloses to a POSITA "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels."

(iv) *'905 Patent, [23-b] "the fiber collimator one or more other ports for second spectral channels"*

850. Lalonde discloses to a POSITA "the fiber collimator one or more other ports for second spectral channels." For example, Lalonde explains that "[t]he input span 11 and output span 12 in FIG. 2 comprise ***a plurality of input and output fibers and the associated ports***,

each carrying a respective multi-channel (DWDM) input/output optical signal." *See id.* at 4:65-5:13 (emphasis added). Lalonde further notes that "the maximum number of channels (wavelengths) on an input port with K, the maximum number of channels (wavelengths) on an output port with K′ the range of an input channel on a port with k, and the range of an output channel on a port with k′. In this way, an input multichannel signal is denoted with Sin(k,i) and an output multichannel signal is denoted with Sout(k′,i′)." *See id.* Figure 2 is reproduced below.

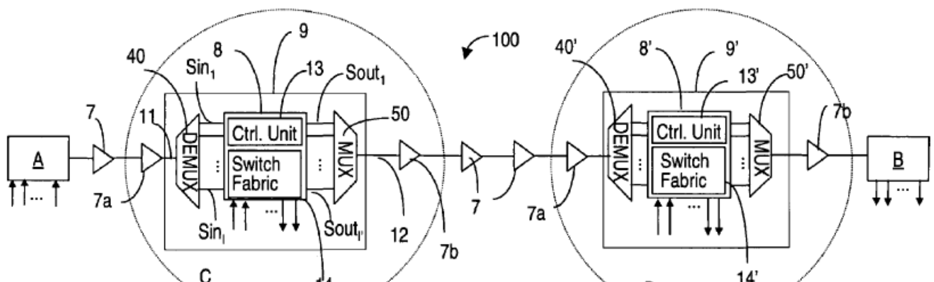
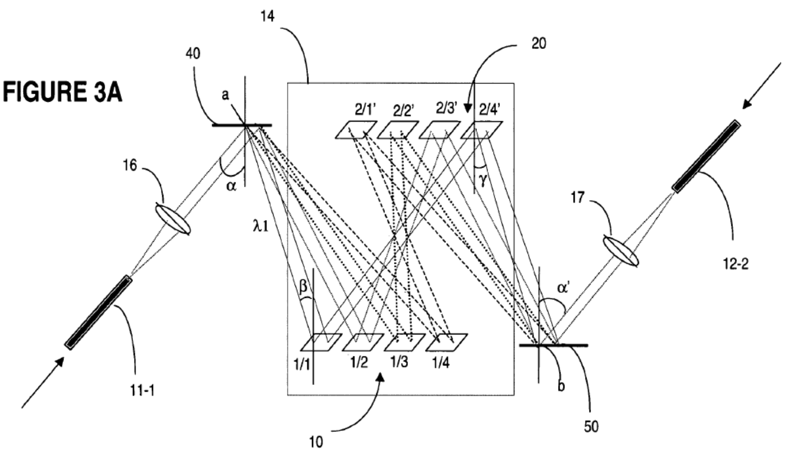


FIGURE 2

851. Furthermore, and as shown in Figures 3A and 3B, reproduced below, "the switch operates according to a wavelength map which results in moving some wavelengths from an input multichannel signal to an output multichannel signal, so that the wavelengths are grouped (multiplexed) differently in the input and output signals." *See* 5:44-49. Figure 3B further shows that each input port includes a collimating lens. Therefore, a POSITA would understand the input ports in Lalonde to be fiber collimator ports. In Lalonde, "[d]iffraction grating 50 operates as a multiplexer, in that it combines light beams into an output multichannel signal Sout(k′,i′), here Sout(4,2) according to the wavelength and the spot of incidence b, and directs signal Sout(4,2) on a respective output fiber 12." *See id.* at 6:36-40.

FIGURE 3A



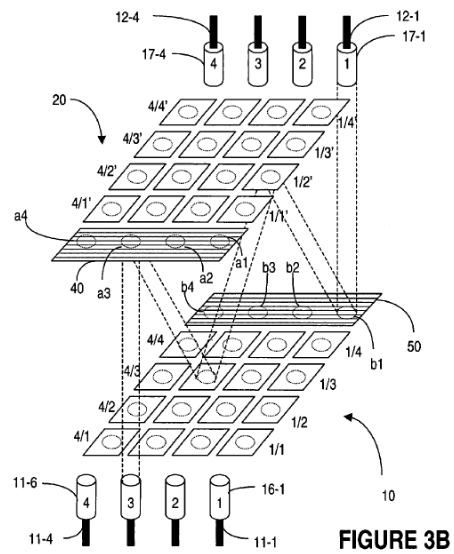


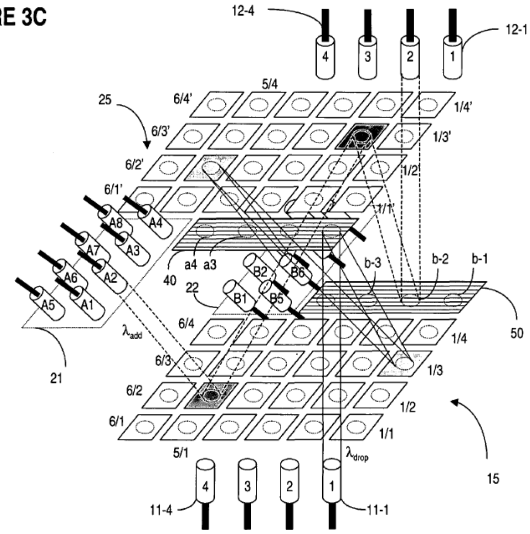
FIGURE 3B

852. With reference to Figure 3B, reproduced above, and Figure 3C, reproduced below, Lalonde explains:

> Each mirror of matrix 20 directs the channel incident on it towards the multiplexer 50 on one of spots b-1 to b-4, depending on the β of the first mirror, the position of the second mirror in matrix 20, and the orientation γ of the second mirror. In FIG. 3B, wavelength λ3 is reflected by mirror 3/3 on mirror 1/2′, which in turn directs this wavelength on diffraction grating 50 spot b-1, for multiplexing it with other wavelengths arriving on spot b-1 and intended to travel over fiber 12-1. . . . The matrices 15 and 25 have an extended number of columns, namely they have in the example of FIG. 3C two additional columns 5 and 6, which could serve 2×4 add ports 21 and 2×4 drop ports 22 respectively. The fibers/ports receiving the add channels are denoted with A1–A8 on FIG. 3C, [while] the fibers/ports transmitting the drop channels are denoted with D1–D8."

See id. at 7:38-52.

FIGURE 3C



853. Lalonde further explains that "[a] drop operation is effected in a similar way. For example, a drop channel λdrop is separated from the input DWDM signal received from input fiber 11-1 by diffraction gratings device 40, which directs this channel from spot a1 to a first mirror 1/3 (shown in light grey) within the switching zone of matrix 15. This first mirror directs the drop channel on a mirror in the drop zone of the matrix 25, which is mirror 5/2′ (also shown in light grey). Then mirror 5/2′ directs the wavelength λdrop to the drop port D1." *See id.* at 8:6-14.

854. Therefore, Lalonde discloses to a POSITA "the fiber collimator one or more other ports for second spectral channels."

(v) *'905 Patent, [23-c] "the output port for an output multi-wavelength optical signal"*

855. Lalonde discloses to a POSITA "the output port for an output multi-wavelength optical signal." For example, Lalonde explains that "[t]he input span 11 and output span 12 in FIG. 2 comprise ***a plurality of input and output fibers and the associated ports***, each carrying a respective multi-channel (DWDM) input/output optical signal." *See id.* at 4:65-5:13 (emphasis added). Lalonde further notes that "the maximum number of channels (wavelengths) on an input

port with K, the maximum number of channels (wavelengths) on an output port with K′ the range of an input channel on a port with k, and the range of an output channel on a port with k′. In this way, an input multichannel signal is denoted with Sin(k,i) and an output multichannel signal is denoted with Sout(k′,i′).” *See id.* Figure 2 is reproduced below.

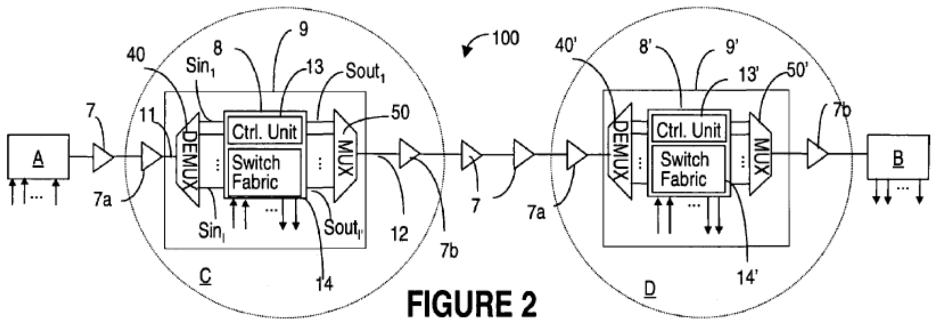
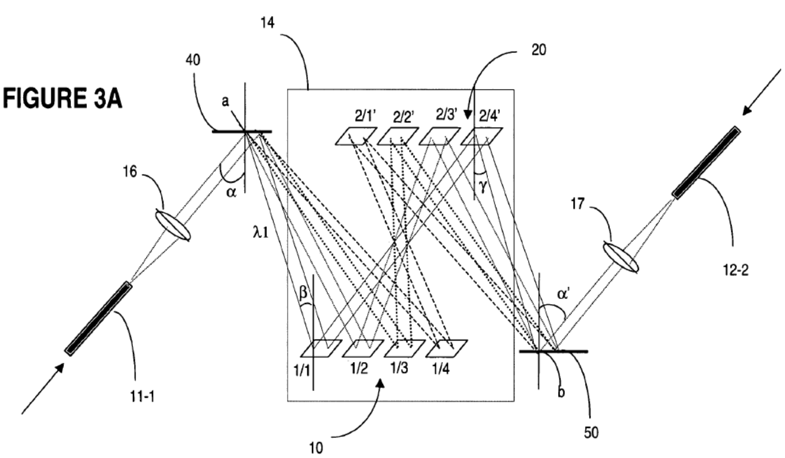


FIGURE 2

856. Furthermore, and as shown in Figures 3A and 3B, reproduced below, “the switch operates according to a wavelength map which results in moving some wavelengths from an input multichannel signal to an output multichannel signal, so that the wavelengths are grouped (multiplexed) differently in the input and output signals.” *See* 5:44-49. In Lalonde, “[d]iffraction grating 50 operates as a multiplexer, in that it combines light beams into an output multichannel signal Sout(k′,i′), here Sout(4,2) according to the wavelength and the spot of incidence b, and directs signal Sout(4,2) on a respective output fiber 12.” *See id.* at 6:36-40.

FIGURE 3A



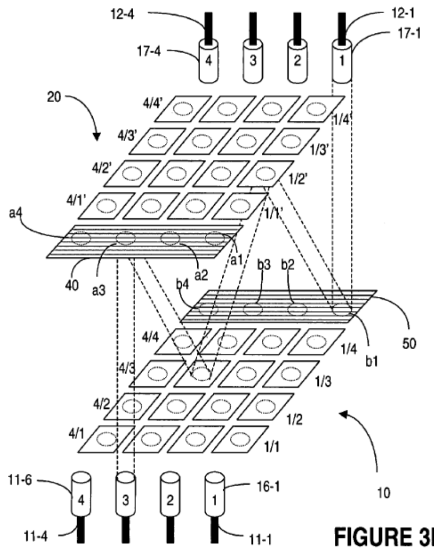


FIGURE 3B

857. Lalonde further explains that "[e]ach mirror of matrix 20 directs the channel incident on it towards the multiplexer 50 on one of spots b-1 to b-4, depending on the β of the first mirror, the position of the second mirror in matrix 20, and the orientation γ of the second mirror. In FIG. 3B, wavelength λ3 is reflected by mirror 3/3 on mirror 1/2′, which in turn directs this wavelength on diffraction grating 50 spot b-1, for multiplexing it with other wavelengths arriving on spot b-1 and intended to travel over fiber 12-1." *See id.* at 7:38-46.

858. Therefore, Lalonde discloses to a POSITA "the output port for an output multi-wavelength optical signal."

(vi) *'905 Patent, [23-d] "a wavelength-selective device for spatially separating said spectral channels"*

859. Lalonde discloses to a POSITA "a wavelength-selective device for spatially separating said spectral channels." For example, Lalonde explains that "[a]t the input side of the switch 9, input signal Sin(k,i), here Sin(4,1) received on input fiber 11-1 is ***separated into four component wavelengths (K=4) by demultiplexer 40***, as also shown in FIG. 2. The demultiplexer is in this example a diffraction grating 40." *See id.* at 5:63-67; *see also id.* at Fig. 2. Once separated, "[t]he diffraction grating 40 reflects each wavelength in the incoming signal

Sin(4,1) on a certain 3-D MEMS device of matrix 10, at an angle of incidence β. The input fiber/port 11-1, diffraction grating 40 and matrix 10 are placed in a predetermined relationship with respect to each other by pre-setting angles α and β. The angles may be pre-set so that each wavelength input from fiber 11-i is incident on a mirror in length i, e.g. λ1 is received on mirror 1/i, λ2 on mirror 2/i, . . . λ_k on mirror k/i, . . . and λ_K on mirror K/i. Preferably fiber 11-1 is associated with column i=1, fiber 11-2 with column i=2, etc." *See id.* at 6:9-19. Lalonde further explains that "[a]s light from the input fiber 11-1 hits grating 40, it is ***split into its component wavelengths***." *See id.* at 6:54-55 (emphasis added).

860. In Lalonde, "[t]he demultiplexer 40 receives the input DWDM signals from the input fibers and separates each DWDM signal into component channels (wavelengths). Thus, the multichannel signal Sin(4,1) from fiber 11-1 is directed on spot a1, the multichannel signal Sin(4,2) from fiber 11-2 is directed on spot a2, etc. A channel λ_k of Sin(k,i) is directed on a first 3-D MEMS mirror k/i of the first matrix 10, according to the port (i) on which it arrives at the switch, and the position of spot a and the wavelength λk. In FIG. 3B, wavelength λ3 arriving to the photonic switch 9 over fiber 11-3 is directed by diffraction grating 40 from spot a3 onto first mirror 3/3." *See id.* at 7:23-33. Thereafter, "[t]he matrices 15 and 25 have an extended number of columns, namely they have in the example of FIG. 3C two additional columns 5 and 6, which could serve 2×4 add ports 21 and 2×4 drop ports 22 respectively. The fibers/ports receiving the add channels are denoted with A1–A8 on FIG. 3C, [while] the fibers/ports transmitting the drop channels are denoted with D1–D8." *See id.* at 7:52-59; *see also id.* at Figs. 3A-3C. Lalonde further explains that "[a] drop operation is effected in a similar way. For example, a drop channel λdrop is separated from the input DWDM signal received from input fiber 11-1 by diffraction gratings device 40, which directs this channel from spot a1 to a first mirror 1/3

(shown in light grey) within the switching zone of matrix 15. This first mirror directs the drop channel on a mirror in the drop zone of the matrix 25, which is mirror 5/2′ (also shown in light grey). Then mirror 5/2′ directs the wavelength λdrop to the drop port D1.” *See id.* at 8:6-14.

861. Therefore, Lalonde discloses to a POSITA “a wavelength-selective device for spatially separating said spectral channels.”

> **(vii)** *’905 Patent, [23-e] “a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port”*

862. Lalonde discloses to a POSITA “a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port.”

863. Lalonde “provides a cost-effective, low-loss system of providing wavelength interchange between multiple WDM line systems.” *See id.* at 3:16-18. In Lalonde, “[t]he switch fabric includes ***two matrices of 3-D MEMS mirrors*** arranged in the same plane, or in two parallel planes. The optical path between the input ports, the demultiplexer and the input matrix is pre-set so that each wavelength is incident on a certain mirror. Similarly, the geometry of the output matrix, the multiplexer and the output ports determines uniquely the wavelengths on a certain port. However, ***the position of the mirrors may be adjusted with a control system, so***

that the path of a wavelength within the switch fabric is adjustable, so that a wavelength input on a port may output the switch on any port." *See id.* at Abstract (emphasis added).

864. Lalonde explains that "3-D MEMS is a term used by the Applicant for ***a mirror mounted on a frame that can be rotated along two axes***, giving it four degrees of freedom" and that "[t]he 3-D MEMS devices are arranged preferably in a matrix, which comprises besides the mirrors ***a control system for positioning the mirrors independently***." *See id.* at 2:32-37 (emphasis added). With reference to Figure 2, reproduced below, Lalonde explains that "[s]witching block 8, 8′ also has a control unit 13, 13′ for controlling the path of the wavelengths within the switch fabric ***from the input ports (connectors) to the output ports***, by adequately orienting the 3D-MEMS devices." *See id.* at 4:61-64 (emphasis added).

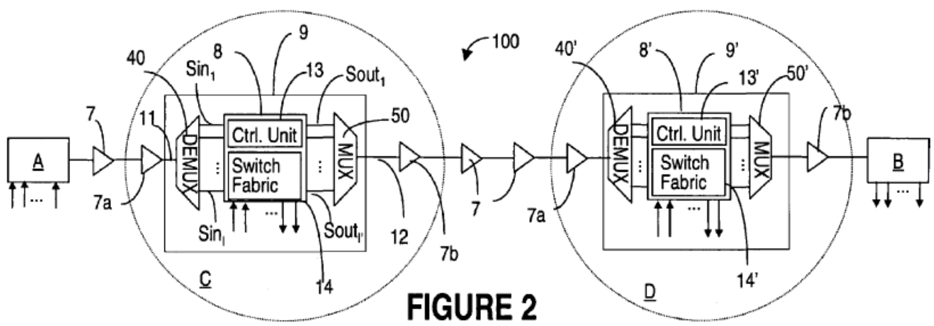
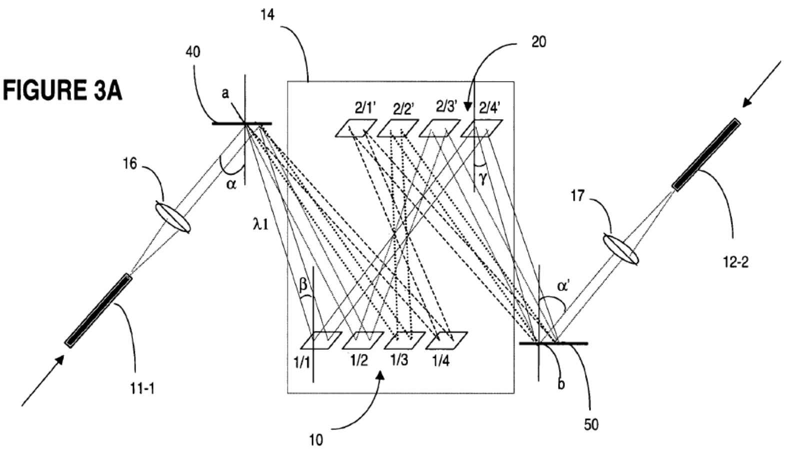


FIGURE 2

865. Figures 3A and 3B, reproduced below, "show how the wavelengths are demultiplexed at the input side of the switch and multiplexed at the output side. As indicated above, the total number of input ports (fibers) is denoted with l and the number of output ports with l', so that the input fibers (ports) are denoted with 11-1 . . . 11-i . . . 11-l and the output fibers (ports) are denoted with 12-1, . . . 12-i', . . . 12-l'. For simplicity, this drawing shows four input wavelengths and four output wavelengths in one plane of the switch. The wavelengths input on fiber 11-1 in this example are output on fiber 12-2. In fact ***the switch operates according to a wavelength map which results in moving some wavelengths from an input***

multichannel signal to an output multichannel signal, so that the wavelengths are grouped (multiplexed) differently in the input and output signals." *See id.* at 5:34-49 (emphasis added).

FIGURE 3A



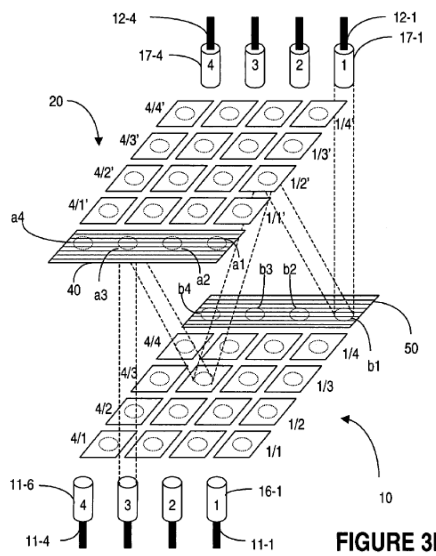


FIGURE 3B

866. Lalonde explains:

> The diffraction grating 40 reflects each wavelength in the incoming signal Sin(4,1) on a certain 3-D MEMS device of matrix 10, at an angle of incidence β. The input fiber/port 11-1, diffraction grating 40 and matrix 10 are placed in a predetermined relationship with respect to each other by pre-setting angles α and β. The angles may be pre-set so that each wavelength input from fiber 11-i is incident on a mirror in length i, e.g. λ1 is received on mirror 1/i, λ2 on mirror 2/i, . . . λ_k on mirror k/i, . . . and λ_K on mirror K/i. Preferably fiber 11-1 is associated with column i=1, fiber 11-2 with column i=2, etc. In turn, ***the mirrors of array 10 direct the respective incident wavelength on a target mirror of MEMS matrix 20***. In the example of FIG. 3A, mirror 1/1 sends λ1 on mirror 2/1′ of MEMS array 20, mirror 1/2 sends λ2 on mirror 2/2′, mirror 1/3 sends λ3 on mirror 2/3′ and

> mirror 1/4 sends λ4 on mirror 2/4′. ***As the mirrors can rotate about two axes, each mirror can redirect wavelength λ1 on any mirror of matrix 20 according to the position of mirror in matrix 10 its orientation (angle β). Angle β may be adjusted as needed by control unit 13. Mirrors of matrix 20 can also rotate about two axes, and each mirror is set to redirect the light towards multiplexer 50.*** The angle β varies with the position of the mirror in matrix 20, angle β, and the orientation of the mirror. The orientation of the 3-D MEMS devices in the matrix 20 is adjusted as needed by control unit 13. . . . As light from the input fiber 11-1 hits grating 40, it is split into its component wavelengths. In order to position the matrix 10 in relation to the gratings 40, the component wavelength map must be known in advance. If the wavelengths change, the mirrors would be out of position. However, as there exists standard wavelengths maps (defined by ITU), this should not occur. If a mirror in matrix 10 has been properly positioned to reflect a particular wavelength, only that wavelength can be incident on that mirror. The reverse is true for the positioning of mirrors in matrix 20 that direct wavelengths to the grating 50 which multiplexes them up and directs them to the output fibers.

See id. at 6:9-66 (emphasis added).

867. Lalonde further explains:

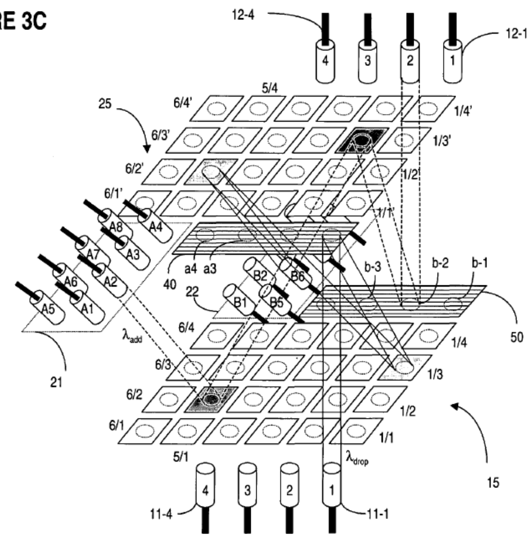
> The demultiplexer 40 receives the input DWDM signals from the input fibers and separates each DWDM signal into component channels (wavelengths). Thus, the multichannel signal Sin(4,1) from fiber 11-1 is directed on spot a1, the multichannel signal Sin(4,2) from fiber 11-2 is directed on spot a2, etc. A channel λ_k of Sin(k,i) is directed on a first 3-D MEMS mirror k/i of the first matrix 10, according to the port (i) on which it arrives at the switch, and the position of spot a and the wavelength λk. In FIG. 3B, wavelength λ3 arriving to the photonic switch 9 over fiber 11-3 is directed by diffraction grating 40 from spot a3 onto first mirror 3/3. From matrix 10, the wavelength is reflected towards a mirror in matrix 20. The second mirror is selected in matrix 20 by the control unit 13, which adjusts the orientation β of the first mirror, according to the current wavelength map. Each mirror of matrix 20 directs the channel incident on it towards the multiplexer 50 on one of spots b-1 to b-4, depending on the β of the first mirror, the position of the second mirror in matrix 20, and the orientation γ of the second mirror.

See id. at 7:23-42.

868. In Figure 3C, reproduced below Lalonde "shows an add channel of wavelength λadd received on fiber A2 of add ports 21. The channel is directed from port A2 on mirror 5/2 (shown in dark grey) of add/drop zone of matrix 15, from where it is reflected on mirror 2/3′ (also shown in dark grey) of matrix 25. Mirror 2/3′ directs the add channel to diffraction

gratings device 50 on area b2 so that add channels λadd is multiplexed over the output fiber corresponding to spot b2, here fiber 12-2." *See id.* at 7:65-8:5. Lalonde notes that "[a] drop operation is effected in a similar way. For example, a drop channel λdrop is separated from the input DWDM signal received from input fiber 11-1 by diffraction gratings device 40, which directs this channel from spot a1 to a first mirror 1/3 (shown in light grey) within the switching zone of matrix 15. This first mirror directs the drop channel on a mirror in the drop zone of the matrix 25, which is mirror 5/2′ (also shown in light grey). Then mirror 5/2′ directs the wavelength λdrop to the drop port D1." *See id.* at 8:6-14.

FIGURE 3C



869. Therefore, Lalonde discloses to a POSITA "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port."

(viii) *'905 Patent, [24] "The optical add-drop apparatus of claim 23 further comprising a control unit for controlling each of said beam-deflecting elements"*

870. Lalonde discloses to a POSITA "a control unit for controlling each of said beam-deflecting elements." For example, Lalonde explains that "the position of the mirrors may be adjusted ***with a control system***, so that the path of a wavelength within the switch fabric is adjustable, so that a wavelength input on a port may output the switch on any port." *See id.* at Abstract (emphasis added). Lalonde provides "a photonic switch for routing a plurality of wavelengths of a DWD transport network, between a plurality of input ports and a plurality of output ports comprising, an all-optical switch fabric for cross-connecting a wavelength λ_k from an optical input multichannel signal Sin(k,i) to an optical output multichannel signal Sout(k',i'), along an adaptable optical path, and ***a control unit for configuring said adaptable optical path***." *Se id.* at 3:7-15 (emphasis added). With reference to Figure 2, reproduced below, Lalonde notes that "[s]witching block 8, 8' also has ***a control unit 13, 13' for controlling the path of the wavelengths*** within the switch fabric from the input ports (connectors) to the output ports, ***by adequately orienting the 3D-MEMS devices***." *See id.* at 4:61-64 (emphasis added).

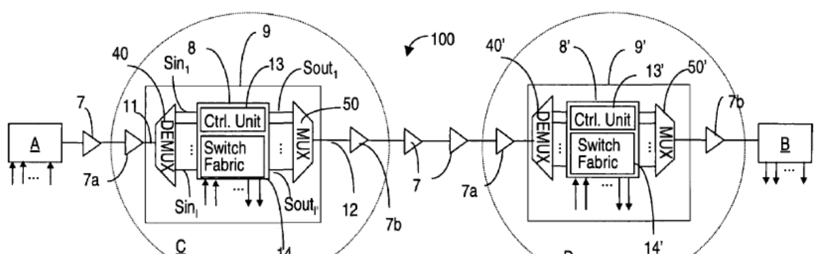


FIGURE 2

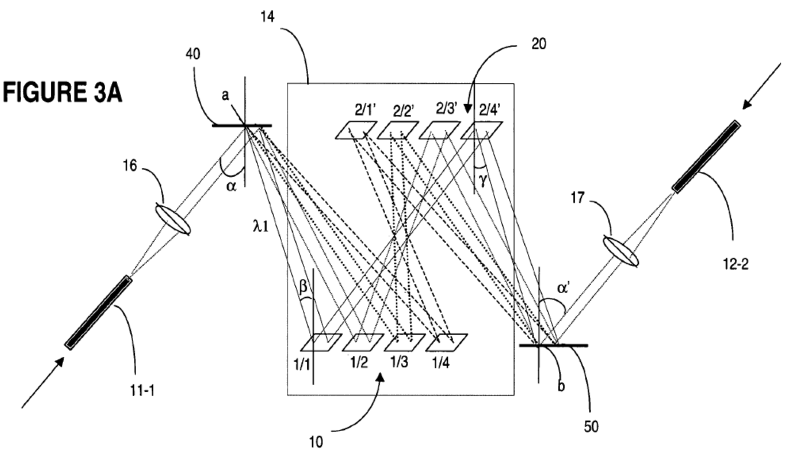
871. With reference to Figure 3A, reproduced below, Lalonde further explains:

> In turn, the mirrors of array 10 direct the respective incident wavelength on a target mirror of MEMS matrix 20. In the example of FIG. 3A, mirror 1/1 sends λ_1 on mirror 2/1' of MEMS array 20, mirror 1/2 sends λ_2 on mirror 2/2', mirror 1/3 sends λ_3 on mirror 2/3' and mirror 1/4 sends λ_4 on mirror 2/4'. As the mirrors can rotate about two axes, each mirror can redirect wavelength λ_1 on any mirror of

> matrix 20 according to the position of mirror in matrix 10 its orientation (angle β). ***Angle β may be adjusted as needed by control unit 13.*** Mirrors of matrix 20 can also rotate about two axes, and each mirror is set to redirect the light towards multiplexer 50. The angle β varies with the position of the mirror in matrix 20, angle β, and the orientation of the mirror. ***The orientation of the 3-D MEMS devices in the matrix 20 is adjusted as needed by control unit 13.***

See id. at 6:20-35 (emphasis added).

FIGURE 3A

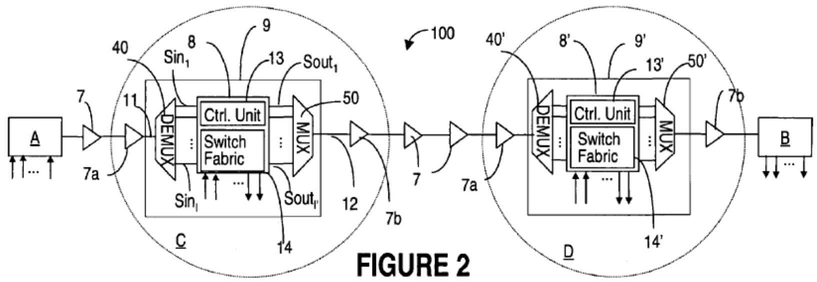


872. Furthermore, Lalonde notes that "[t]he control unit . . . [is] not illustrated, for simplification" in Figures 3B and 3C, reproduced below. *See id.* at 7:8-12; *see also id.* at Figs. 3B, 3C. Similarly, the "[c]ontrol unit 13 is not illustrated for simplification in Figure 4A and 4B. *See id.* at 8:22-26; *see also id.* at Figs. 4A, 4B. Lalonde explains, however, that "[f]rom matrix 10, the wavelength is reflected towards a mirror in matrix 20. The second mirror is selected in matrix 20 by the control unit 13, which adjusts the orientation β of the first mirror, according to the current wavelength map. Each mirror of matrix 20 directs the channel incident on it towards the multiplexer 50 on one of spots b-1 to b-4, depending on the β of the first mirror, the position of the second mirror in matrix 20, and the orientation γ of the second mirror. In FIG. 3B, wavelength λ_3 is reflected by mirror 3/3 on mirror 1/2', which in turn directs this wavelength on diffraction grating 50 spot b-1, for multiplexing it with other wavelengths arriving on spot b-1 and intended to travel over fiber 12-1." *See id.* at 7:34-46.

873. Therefore, Lalonde discloses to a POSITA "a control unit for controlling each of said beam-deflecting elements."

(ix) *'905 Patent, [25] "The optical add-drop apparatus of claim 24, wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements"*

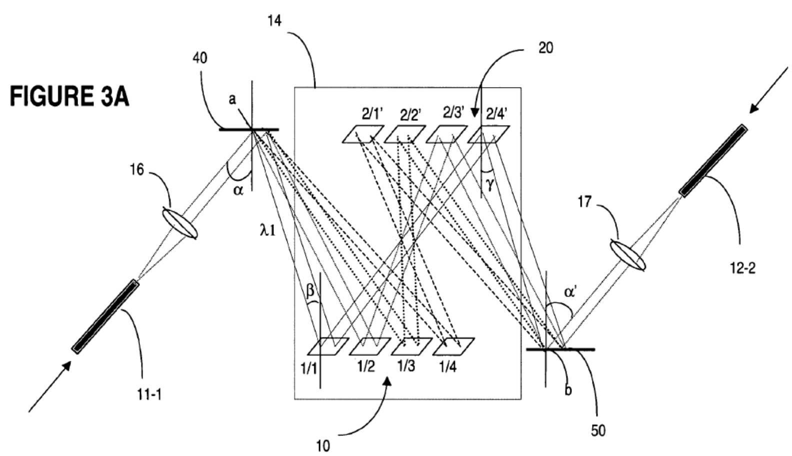
874. Lalonde discloses to a POSITA "wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements." For example, Lalonde explains that "the position of the mirrors may be adjusted ***with a control system***, so that the path of a wavelength within the switch fabric is adjustable, so that a wavelength input on a port may output the switch on any port." *See id.* at Abstract (emphasis added). Lalonde provides "a photonic switch for routing a plurality of wavelengths of a DWD transport network, between a plurality of input ports and a plurality of output ports comprising, an all-optical switch fabric for cross-connecting a wavelength λ_k from an optical input multichannel signal Sin(k,i) to an optical output multichannel signal Sout(k',i'), along an adaptable optical path, and ***a control unit for configuring said adaptable optical path***." *Se id.* at 3:7-15 (emphasis added). With reference to Figure 2, reproduced below, Lalonde notes that "[s]witching block 8, 8' also has ***a control unit 13, 13' for controlling the path of the wavelengths*** within the switch fabric from the input ports (connectors) to the output ports, ***by adequately orienting the 3D-MEMS devices***." *See id.* at 4:61-64 (emphasis added).



875. With reference to Figure 3A, reproduced below, Lalonde further explains:

> In turn, the mirrors of array 10 direct the respective incident wavelength on a target mirror of MEMS matrix 20. In the example of FIG. 3A, mirror 1/1 sends λ_1 on mirror 2/1' of MEMS array 20, mirror 1/2 sends λ_2 on mirror 2/2', mirror 1/3 sends λ_3 on mirror 2/3' and mirror 1/4 sends λ_4 on mirror 2/4'. As the mirrors can rotate about two axes, each mirror can redirect wavelength λ_1 on any mirror of matrix 20 according to the position of mirror in matrix 10 its orientation (angle β). ***Angle β may be adjusted as needed by control unit 13.*** Mirrors of matrix 20 can also rotate about two axes, and each mirror is set to redirect the light towards multiplexer 50. The angle β varies with the position of the mirror in matrix 20, angle β, and the orientation of the mirror. ***The orientation of the 3-D MEMS devices in the matrix 20 is adjusted as needed by control unit 13.***

See id. at 6:20-35 (emphasis added).



876. Furthermore, Lalonde notes that "[t]he control unit . . . [is] not illustrated, for simplification" in Figures 3B and 3C, reproduced below. *See id.* at 7:8-12; *see also id.* at Figs. 3B, 3C. Similarly, the "[c]ontrol unit 13 is not illustrated for simplification in Figure 4A and 4B. *See id.* at 8:22-26; *see also id.* at Figs. 4A, 4B. Lalonde explains, however, that "[f]rom matrix 10, the wavelength is reflected towards a mirror in matrix 20. The second mirror is

selected in matrix 20 by the control unit 13, which adjusts the orientation β of the first mirror, according to the current wavelength map. Each mirror of matrix 20 directs the channel incident on it towards the multiplexer 50 on one of spots b-1 to b-4, depending on the β of the first mirror, the position of the second mirror in matrix 20, and the orientation γ of the second mirror. In FIG. 3B, wavelength λ_3 is reflected by mirror 3/3 on mirror 1/2', which in turn directs this wavelength on diffraction grating 50 spot b-1, for multiplexing it with other wavelengths arriving on spot b-1 and intended to travel over fiber 12-1." *See id.* at 7:34-46.

877. Therefore, Lalonde discloses to a POSITA "wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements." Even if Lalonde does not teach "a servo-control assembly[,]" this limitation would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(x) *'905 Patent, [26] "The optical add-drop apparatus of claim 25, wherein said servo-control assembly maintains said power levels at predetermined values"*

878. To the extent Lalonde does not teach "wherein said servo-control assembly maintains said power levels at predetermined values[,]"these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

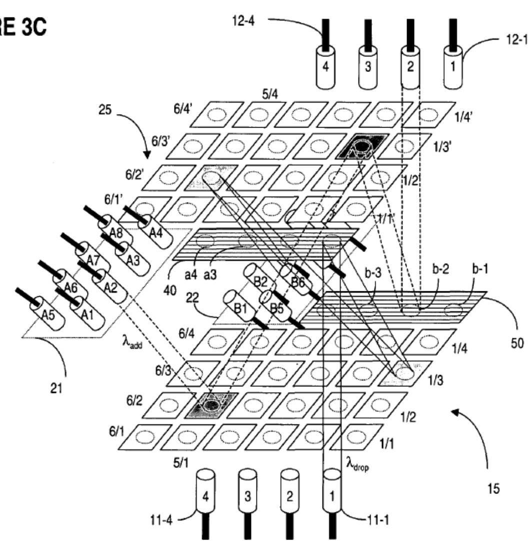
(xi) *'905 Patent, [27] "The optical add-drop apparatus of claim 24, wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal"*

879. Lalonde discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal." With reference to Figure 3C, reproduced below, Lalonde explains:

> FIG. 3C shows a spatial view of a photonic switch 9 with integrated add/drop, and examples of add and drop operations. It is again noted that according to the invention, there is no need to provide a separate OADM. 3D-MEMS matrix 15 provides the add functionality, at while ***3D-MEMS matrix 25 provides the drop functionality***. The matrices 15 and 25 have an extended number of columns, namely they have in the example of FIG. 3C two additional columns 5 and 6, which could serve 2×4 add ports 21 and 2×4 drop ports 22 respectively. The fibers/ports receiving the add channels are denoted with A1 A8 on FIG. 3C, and ***the fibers/ports transmitting the drop channels are denoted with D1 D8***. The add/drop operations use these zones, and therefore the zone on matrix 15 defined by rows 1 4 an columns 5, 6 is the add zone, while ***the zone on matrix 25 defined by rows 1' 4' an columns 5', 6' is the drop zone***. The remaining area (rows 14, columns 1 4) on each matrix is defined as the switching zone.

See id. at 7:47-64 (emphasis added).

FIGURE 3C



880. Lalonde further explains that "FIG. 4A is a schematic diagram of another embodiment of the photonic switch 9 according to the invention, and FIG. 4B is a side view of the embodiment in FIG. 4A" and notes that "[c]ontrol unit 13 is not illustrated for simplification[, and, therefore, Figures 4A and 4B] do not illustrate add/drop operations." *See id.* at 8:22-26. Figures 4A and 4B are reproduced below.

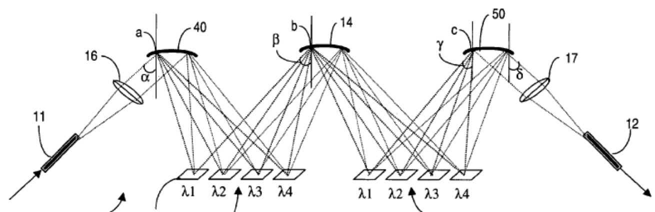


FIGURE 4A

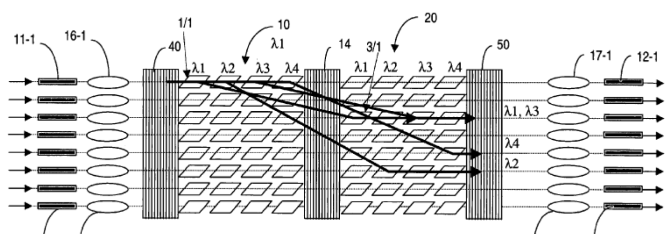


FIGURE 4B

881. Lalonde further explains that the control unit controls the 3D MEMs matrix to direct certain wavelengths to the drop ports. For example, Lalonde explains that "the position of the mirrors may be adjusted ***with a control system***, so that the path of a wavelength within the switch fabric is adjustable, so that a wavelength input on a port may output the switch on any port." *See id.* at Abstract (emphasis added). Lalonde provides "a photonic switch for routing a plurality of wavelengths of a DWD transport network, between a plurality of input ports and a plurality of output ports comprising, an all-optical switch fabric for cross-connecting a wavelength λ_k from an optical input multichannel signal Sin(k,i) to an optical output multichannel signal Sout(k',i'), along an adaptable optical path, and ***a control unit for configuring said adaptable optical path***." *Se id.* at 3:7-15 (emphasis added). With reference to

Figure 2, reproduced below, Lalonde notes that "[s]witching block 8, 8' also has ***a control unit 13, 13' for controlling the path of the wavelengths*** within the switch fabric from the input ports (connectors) to the output ports, ***by adequately orienting the 3D-MEMS devices***." *See id.* at 4:61-64 (emphasis added).

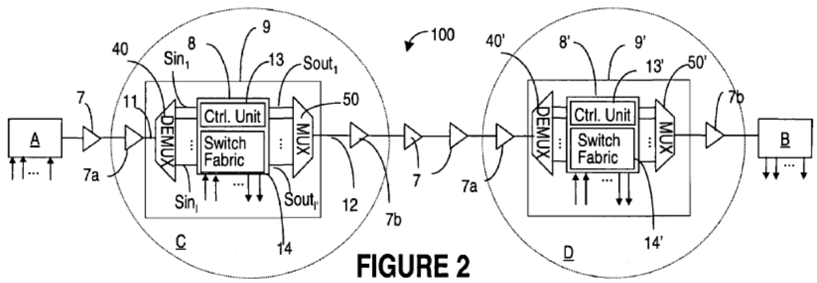


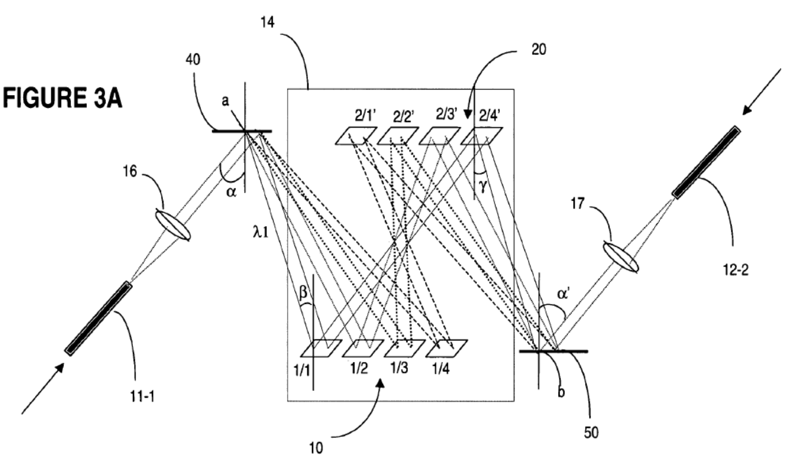
FIGURE 2

882. With reference to Figure 3A, reproduced below, Lalonde further explains:

> In turn, the mirrors of array 10 direct the respective incident wavelength on a target mirror of MEMS matrix 20. In the example of FIG. 3A, mirror 1/1 sends λ_1 on mirror 2/1' of MEMS array 20, mirror 1/2 sends λ_2 on mirror 2/2', mirror 1/3 sends λ_3 on mirror 2/3' and mirror 1/4 sends λ_4 on mirror 2/4'. As the mirrors can rotate about two axes, each mirror can redirect wavelength λ_1 on any mirror of matrix 20 according to the position of mirror in matrix 10 its orientation (angle β). ***Angle β may be adjusted as needed by control unit 13.*** Mirrors of matrix 20 can also rotate about two axes, and each mirror is set to redirect the light towards multiplexer 50. The angle β varies with the position of the mirror in matrix 20, angle β, and the orientation of the mirror. ***The orientation of the 3-D MEMS devices in the matrix 20 is adjusted as needed by control unit 13.***

See id. at 6:20-35 (emphasis added).

FIGURE 3A



883. Furthermore, Lalonde notes that "[t]he control unit . . . [is] not illustrated, for simplification" in Figures 3B and 3C, reproduced below. *See id.* at 7:8-12; *see also id.* at Figs. 3B, 3C. Lalonde explains, however, that "[f]rom matrix 10, the wavelength is reflected towards a mirror in matrix 20. The second mirror is selected in matrix 20 by the control unit 13, which adjusts the orientation β of the first mirror, according to the current wavelength map. Each mirror of matrix 20 directs the channel incident on it towards the multiplexer 50 on one of spots b-1 to b-4, depending on the β of the first mirror, the position of the second mirror in matrix 20, and the orientation γ of the second mirror. In FIG. 3B, wavelength λ_3 is reflected by mirror 3/3 on mirror 1/2', which in turn directs this wavelength on diffraction grating 50 spot b-1, for multiplexing it with other wavelengths arriving on spot b-1 and intended to travel over fiber 12-1." *See id.* at 7:34-46.

884. Therefore, Lalonde discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal."

(xii) *'905 Patent, [28] "The optical add-drop apparatus of claim 24, wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal"*

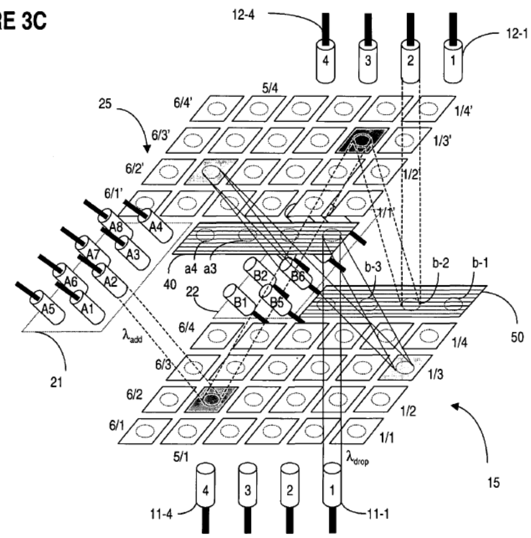
885. Lalonde discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal." With reference to Figure 3C, reproduced below, Lalonde explains:

> FIG. 3C shows a spatial view of a photonic switch 9 with integrated add/drop, and examples of add and drop operations. It is again noted that according to the invention, there is no need to provide a separate OADM. ***3D-MEMS matrix 15***

> ***provides the add functionality***, at while 3D-MEMS matrix 25 provides the drop functionality. The matrices 15 and 25 have an extended number of columns, namely they have in the example of FIG. 3C two additional columns 5 and 6, which could serve 2×4 add ports 21 and 2×4 drop ports 22 respectively. ***The fibers/ports receiving the add channels are denoted with A1 A8 on FIG. 3C***, and the fibers/ports transmitting the drop channels are denoted with D1 D8. The add/drop operations use these zones, and therefore ***the zone on matrix 15 defined by rows 1 4 an columns 5, 6 is the add zone***, while the zone on matrix 25 defined by rows 1' 4' an columns 5', 6' is the drop zone. The remaining area (rows 14, columns 1 4) on each matrix is defined as the switching zone.

See id. at 7:47-64 (emphasis added).

FIGURE 3C



886. Lalonde further explains that "FIG. 4A is a schematic diagram of another embodiment of the photonic switch 9 according to the invention, and FIG. 4B is a side view of the embodiment in FIG. 4A" and notes that "[c]ontrol unit 13 is not illustrated for simplification[, and, therefore, Figures 4A and 4B] do not illustrate add/drop operations." *See id.* at 8:22-26. Figures 4A and 4B are reproduced below.

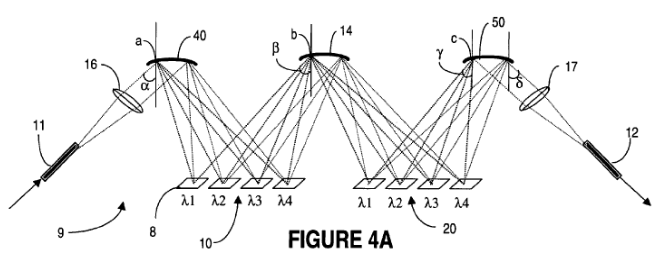


FIGURE 4A

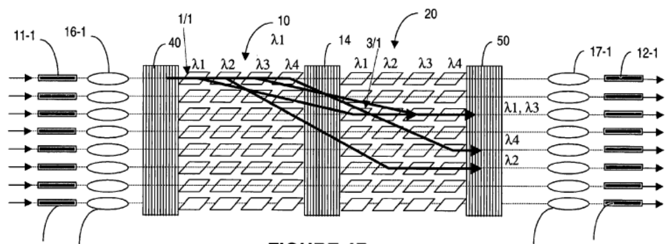


FIGURE 4B

887. Lalonde further explains that the control unit controls the 3D MEMs matrix to direct certain wavelengths to the add ports. For example, Lalonde explains that "the position of the mirrors may be adjusted ***with a control system***, so that the path of a wavelength within the switch fabric is adjustable, so that a wavelength input on a port may output the switch on any port." *See id.* at Abstract (emphasis added). Lalonde provides "a photonic switch for routing a plurality of wavelengths of a DWD transport network, between a plurality of input ports and a plurality of output ports comprising, an all-optical switch fabric for cross-connecting a wavelength λ_k from an optical input multichannel signal Sin(k,i) to an optical output multichannel signal Sout(k',i'), along an adaptable optical path, and ***a control unit for configuring said adaptable optical path***." *Se id.* at 3:7-15 (emphasis added). With reference to Figure 2, reproduced below, Lalonde notes that "[s]witching block 8, 8' also has ***a control unit 13, 13' for controlling the path of the wavelengths*** within the switch fabric from the input ports (connectors) to the output ports, ***by adequately orienting the 3D-MEMS devices***." *See id.* at 4:61-64 (emphasis added).

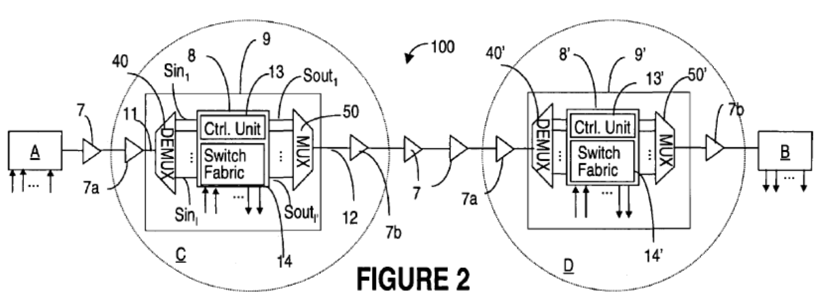
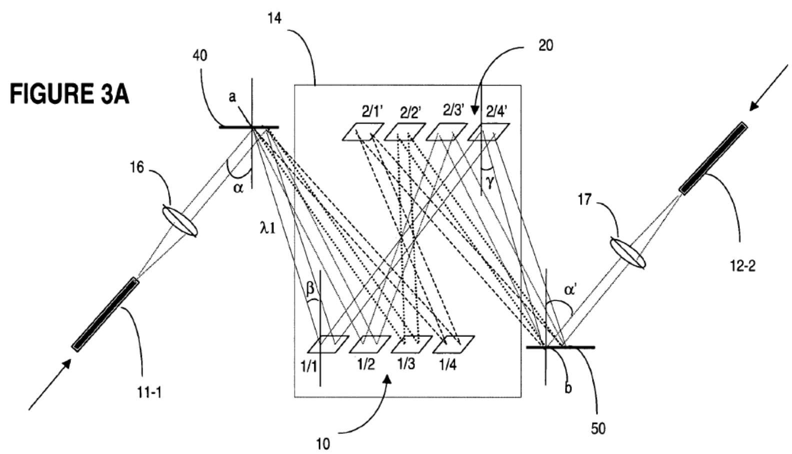


FIGURE 2

888. With reference to Figure 3A, reproduced below, Lalonde further explains:

> In turn, the mirrors of array 10 direct the respective incident wavelength on a target mirror of MEMS matrix 20. In the example of FIG. 3A, mirror 1/1 sends λ_1 on mirror 2/1' of MEMS array 20, mirror 1/2 sends λ_2 on mirror 2/2', mirror 1/3 sends λ_3 on mirror 2/3' and mirror 1/4 sends λ_4 on mirror 2/4'. As the mirrors can rotate about two axes, each mirror can redirect wavelength λ_1 on any mirror of matrix 20 according to the position of mirror in matrix 10 its orientation (angle β). ***Angle β may be adjusted as needed by control unit 13.*** Mirrors of matrix 20 can also rotate about two axes, and each mirror is set to redirect the light towards multiplexer 50. The angle β varies with the position of the mirror in matrix 20, angle β, and the orientation of the mirror. ***The orientation of the 3-D MEMS devices in the matrix 20 is adjusted as needed by control unit 13.***

See id. at 6:20-35 (emphasis added).



889. Furthermore, Lalonde notes that "[t]he control unit . . . [is] not illustrated, for simplification" in Figures 3B and 3C, reproduced below. *See id.* at 7:8-12; *see also id.* at Figs. 3B, 3C. Lalonde explains, however, that "[f]rom matrix 10, the wavelength is reflected towards a mirror in matrix 20. The second mirror is selected in matrix 20 by the control unit 13, which adjusts the orientation β of the first mirror, according to the current wavelength map. Each mirror of matrix 20 directs the channel incident on it towards the multiplexer 50 on one of spots b-1 to b-4, depending on the β of the first mirror, the position of the second mirror in matrix 20, and the orientation γ of the second mirror. In FIG. 3B, wavelength λ_3 is reflected by mirror 3/3 on mirror 1/2', which in turn directs this wavelength on diffraction grating 50 spot b-1, for

multiplexing it with other wavelengths arriving on spot b-1 and intended to travel over fiber 12-1." *See id.* at 7:34-46.

890. Therefore, Lalonde discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal."

> **(xiii)** *'905 Patent, [29] "The optical add-drop apparatus of claim 23 further comprising alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device"*

891. Lalonde discloses to a POSITA "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device." For example, Lalonde explains that "[d]iffraction grating 50 operates as a multiplexer, in that it combines light beams into an output multichannel signal Sout(k',i'), here Sout(4,2) according to the wavelength and the spot of incidence b, and ***directs signal Sout(4,2) on a respective output fiber 12***. Again, the wavelength-output port-mirror assignment is preferably predetermined." *See id.* at 6:36-41 (emphasis added); *see also id.* at Figs. 3A-3C. Lalonde further explains that "[d]evice 50 reflects the light incident on it at an output angle δ to focusing lens 17-3, and from there to output fiber 12-3. In the example of FIG. 3B, wavelength λ_3 is combined with λ_1 by device 50, as these wavelengths are directed by the respective mirrors in matrix 20 onto fiber 12-3." *See id.* at 9:4-8; *see also id.* at Figs. 4A, 4B. In Lalonde, "[t]he terminal at site A converts a plurality of electrical signals input to the optical network 1 to optical signals, and combines the optical signals into a WDM signal. At the far end B, the WDM signal is demultiplexed into individual optical signals, which are converted back to electrical signals." *See id.* at 3:59-64.

892. Lalonde notes:

> The integrated photonic switch can be used in all-optical networks. incoming multiplexed signals from a number of input fiber ports are separated into their component wavelengths. Individual wavelengths are switched within the switch fabric towards the desired output, and the wavelengths are then multiplexed into WDM signals directed to the appropriate output ports. The multiplexer and demultiplexer are diffraction grating devices, integrated with the switch fabric. The switch fabric includes two matrices of 3-D MEMS mirrors arranged in the same plane, or in two parallel planes. The optical path between the input ports, the demultiplexer and the input matrix is pre-set so that each wavelength is incident on a certain mirror. Similarly, ***the geometry of the output matrix, the multiplexer and the output ports determines uniquely the wavelengths on a certain port***. However, the position of the mirrors may be adjusted with a control system, so that the path of a wavelength within the switch fabric is adjustable, so that a wavelength input on a port may output the switch on any port.

See id. at Abstract (emphasis added).

893. Therefore, Lalonde discloses to a POSITA "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device."

(xiv) *'905 Patent, [31] "The optical add-drop apparatus of claim 23, wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal"*

894. Lalonde discloses to a POSITA "wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal." For example, Lalonde explains that "[d]iffraction grating 50 operates as a multiplexer, in that ***it combines light beams into an output multichannel signal Sout(k',i'), here Sout(4,2) according to the wavelength and the spot of incidence b***, and directs signal Sout(4,2) on a respective output fiber 12. Again, the wavelength-output port-mirror assignment is preferably predetermined." *See id.* at 6:36-41 (emphasis added); *see also id.* at Figs. 3A-3C. Lalonde further explains that "[d]evice 50

reflects the light incident on it at an output angle δ to focusing lens 17-3, and from there to output fiber 12-3. In the example of FIG. 3B, wavelength λ_3 is combined with λ_1 by device 50, as these wavelengths are directed by the respective mirrors in matrix 20 onto fiber 12-3." *See id.* at 9:4-8; *see also id.* at Figs. 4A, 4B. In Lalonde, "[t]he terminal at site A converts a plurality of electrical signals input to the optical network 1 to optical signals, and combines the optical signals into a WDM signal. At the far end B, the WDM signal is demultiplexed into individual optical signals, which are converted back to electrical signals." *See id.* at 3:59-64.

895. Lalonde notes:

> The integrated photonic switch can be used in all-optical networks. incoming multiplexed signals from a number of input fiber ports are separated into their component wavelengths. Individual wavelengths are switched within the switch fabric towards the desired output, and ***the wavelengths are then multiplexed into WDM signals directed to the appropriate output ports***. The multiplexer and demultiplexer are diffraction grating devices, integrated with the switch fabric. The switch fabric includes two matrices of 3-D MEMS mirrors arranged in the same plane, or in two parallel planes. The optical path between the input ports, the demultiplexer and the input matrix is pre-set so that each wavelength is incident on a certain mirror. Similarly, ***the geometry of the output matrix, the multiplexer and the output ports determines uniquely the wavelengths on a certain port***. However, the position of the mirrors may be adjusted with a control system, so that the path of a wavelength within the switch fabric is adjustable, so that a wavelength input on a port may output the switch on any port.

See id. at Abstract (emphasis added).

896. Therefore, Lalonde discloses to a POSITA "wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal."

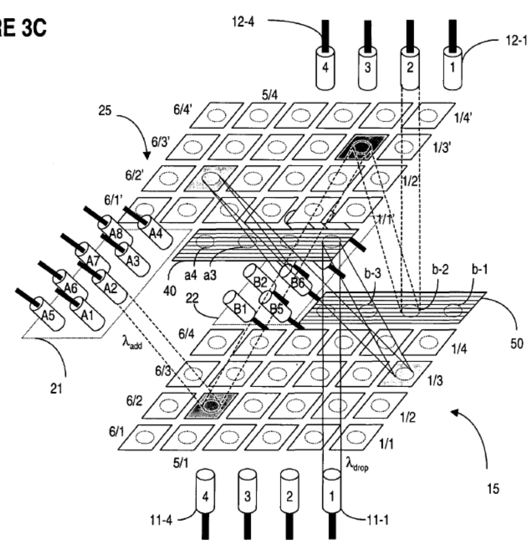
(xv) *'905 Patent, [32] "The optical add-drop apparatus of claim 23, wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels"*

897. Lalonde discloses to a POSITA "wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels." With reference to Figure 3C, reproduced below, Lalonde explains:

> FIG. 3C shows a spatial view of a photonic switch 9 with integrated add/drop, and examples of add and drop operations. It is again noted that according to the invention, there is no need to provide a separate OADM. ***3D-MEMS matrix 15 provides the add functionality***, at while ***3D-MEMS matrix 25 provides the drop functionality***. The matrices 15 and 25 have an extended number of columns, namely they have in the example of FIG. 3C two additional columns 5 and 6, which could serve 2×4 add ports 21 and 2×4 drop ports 22 respectively. ***The fibers/ports receiving the add channels are denoted with A1 A8 on FIG. 3C, and the fibers/ports*** transmitting ***the drop channels are denoted with D1 D8. The add/drop operations use these zones, and therefore the zone on matrix 15 defined by rows 1 4 an columns 5, 6 is the add zone, while the zone on matrix 25 defined by rows 1' 4' an columns 5', 6' is the drop zone.*** The remaining area (rows 14, columns 1 4) on each matrix is defined as the switching zone.

See id. at 7:47-64 (emphasis added).

FIGURE 3C



898. Lalonde also notes:

> A drop operation is effected in a similar way. For example, a drop channel λ_{drop} is separated from the input DWDM signal received from input fiber 11-1 by diffraction gratings device 40, which directs this channel from spot a1 to a first mirror 1/3 (shown in light grey) within the switching zone of matrix 15. This first mirror directs the drop channel on a mirror in the drop zone of the matrix 25, which is mirror 5/2' (also shown in light grey). Then mirror 5/2' directs the wavelength λ_{drop} to the drop port D1. It is possible to have differently sized add/drop zones on the first and second matrices. In the general case, for an add zone with m rows and n columns, there will be m add ports (fibers), and a maximum of n wavelengths on each add fiber. For a drop zone with m' rows and n' columns, there will be m'drop fibers, and a maximum of m'wavelengths on each fiber.

See id. at 8:6-21.

899. Lalonde further explains that "FIG. 4A is a schematic diagram of another embodiment of the photonic switch 9 according to the invention, and FIG. 4B is a side view of the embodiment in FIG. 4A" and notes that "[c]ontrol unit 13 is not illustrated for simplification[, and, therefore, Figures 4A and 4B] do not illustrate add/drop operations." *See id.* at 8:22-26. Figures 4A and 4B are reproduced below.

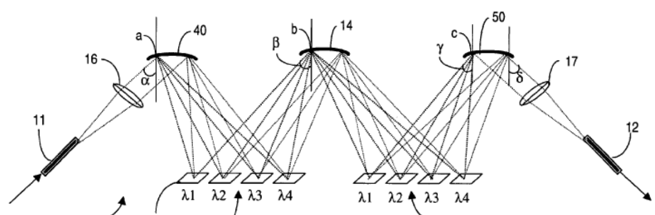


FIGURE 4A

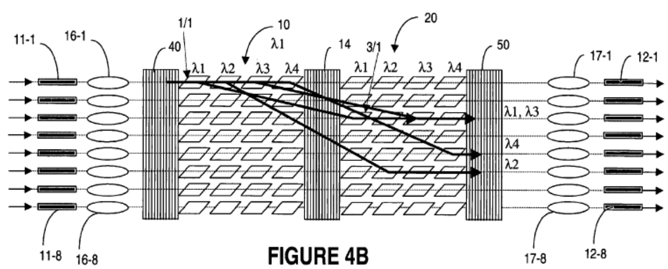


FIGURE 4B

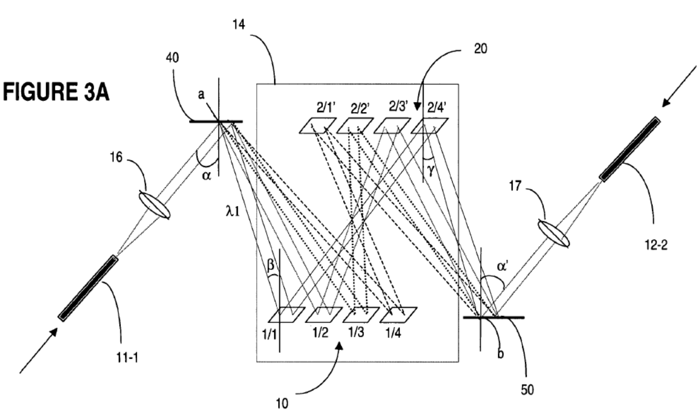
900. Lalonde further explains that a fiber collimator add port and a fiber collimator drop port can add second and drop first spectral channels, respectively. *See id.* at Abstract, 2:48-3:15, 4:65-5:13, 5:34-49, 5:63-6:19, 6:64-7:7, 7:13-22, 8:27-51, Figs. 3A-3B.

901. Therefore, Lalonde discloses to a POSITA "wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels."

(xvi) *'905 Patent, [33] "The optical add-drop apparatus of claim 23 further comprising a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements"*

902. Lalonde discloses to a POSITA "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements." For example, Lalonde explains that "[f]iber 11-1, as well as all remaining input fibers, is aligned to direct the incoming light on collimating lens 16, which in turn directs the wavelengths on diffraction grating 40 on a certain area (spot) noted with a, and at an angle of incidence α. The term spot is used herein to define the area of incidence of a beam of light, as shown in FIG. 3A by letters a and b, and as intuitively shown for example in FIG. 3B by dotted circles marked a1 to a4 and by to b4." *See id.* at 5:63-6:8. Lalonde further explains that "[d]evice 50 reflects the light incident on it at an output angle δ to focusing lens 17-3, and from there to output fiber 12-3. In the example of FIG. 3B, wavelength λ_3 is combined with λ_1 by device 50, as these wavelengths are directed by the respective mirrors in matrix 20 onto fiber 12-3." *See id.* at 9:4-8. Figures 3A and 3B are reproduced below.

FIGURE 3A



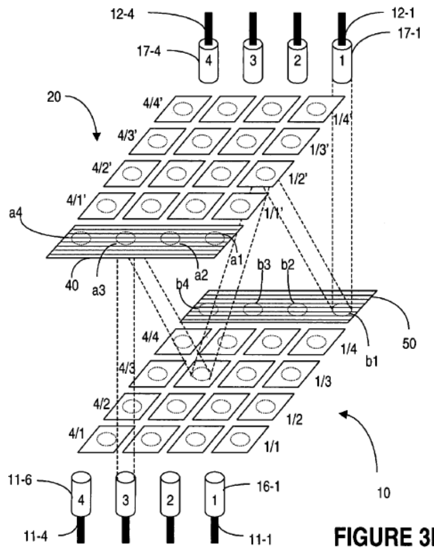


FIGURE 3B

903. Figure 3B, reproduced above, "shows a perspective view of a switch fabric with 3-D MEMS matrices 10 and 20, for switching 4-channel signals input on four fibers 11-1 to 11-4 to output fibers 12-1 to 12-4. The control unit, the ***focusing lens*** and collimating lens are not illustrated, for simplification." *See id.* at 7:8-12; *see also id.* at Fig. 3C. Lalonde further explains that "[t]he output of the photonic switch 9 is also provided with a focusing lens 17, for focusing the wavelengths form spot b on the fiber 12-2." *See id.* at 6:42-44.

904. Figures 4A, reproduced below, also shows "the collimating and focusing lenses 16 and 17, demultiplexer 40 and multiplexer 50 in the form of diffraction gratings devices, and the 3D-MEMS matrices 10 and 20," as well as "an additional diffraction grating device 14 arranged in the path of the light between the two matrices 40 and 50." *See id.* at 8:27-35; *see also id.* at 8:36-45, Figs. 4A, 4B.

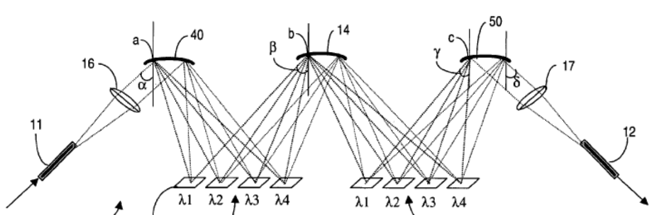


FIGURE 4A

905. Therefore, Lalonde discloses to a POSITA "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements."

> **(xvii)** *'905 Patent, [34] "The optical add-drop apparatus of claim 23, wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms"*

906. Lalonde discloses to a POSITA "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms." For example, Lalonde provides that "incoming multiplexed signals from a number of input fiber ports are separated [(*i.e.*, demultiplexed)] into their component wavelengths," "[i]ndividual wavelengths are switched within the switch fabric towards the desired output, and the wavelengths are then multiplexed into WDM signals directed to the appropriate output ports." *See id.* at Abstract. Lalonde notes that "[t]he multiplexer and demultiplexer are ***diffraction grating devices***, integrated with the switch fabric." *See id.* (emphasis added); *see also id.* at 5:63-6:19, 6:36-41, 6:52-63, 7:23-46, 7:65-8:14, 8:27-35, 8:46-9:3, Figs. 3A, 4A, 4B.

907. Therefore, Lalonde discloses to a POSITA "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."

> **(xviii)** *'905 Patent, [35] "The optical add-drop apparatus of claim 23, wherein said beam-deflecting elements comprise micromachined mirrors"*

908. Lalonde discloses to a POSITA "wherein said beam-deflecting elements comprise micromachined mirrors." For example, Lalonde explains that "[t]he switch fabric includes two matrices of 3-D MEMS mirrors arranged in the same plane, or in two parallel planes." *See id.* at

Abstract; *see also id.* at 6:20-35, 7:13-33, 8:46-60, Figs. 3A-4B. Lalonde also notes that "MEM mirrors technology has evolved lately. The '3-D MEMS' devices have emerged as the photonic switch technology of choice for large fabric switches. ***3-D MEMS is a term used by the Applicant for a mirror mounted on a frame that can be rotated along two axes, giving it four degrees of freedom.*** The 3-D MEMS devices are arranged preferably in a matrix, which comprises besides the mirrors a control system for positioning the mirrors independently." *See id.* at 2:30-37 (emphasis added).

909. Therefore, Lalonde discloses to a POSITA "wherein said beam-deflecting elements comprise micromachined mirrors."

(xix) *'905 Patent, [37] "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator"*

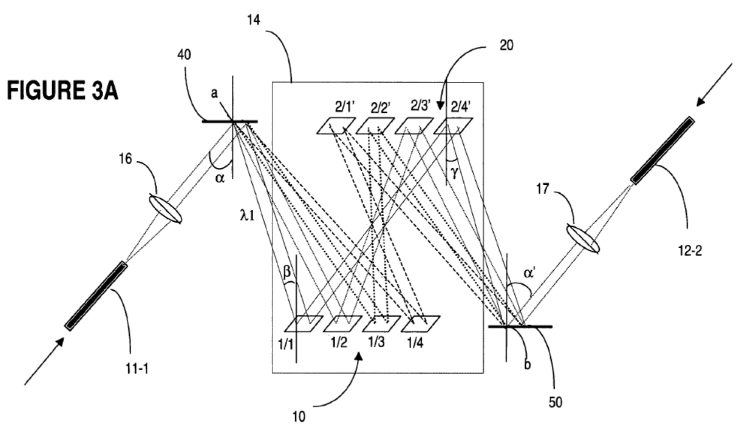
910. Lalonde discloses to a POSITA "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator." Specifically, Lalonde does not disclose the use of circulators anywhere in its optical add-drop apparatus. Instead, Lalonde discloses "a plurality of input and output fibers and the associated ports, each carrying a respective multi-channel (DWDM) input/output optical signal." *See id.* at 4:65-5:13; *see also id.* at 4:5-11, 4:46-51, 4:61-64, 5:23-28, Figs. 1, 2. Lalonde also explains that "the total number of ***input ports (fibers)*** is denoted with l and the number of output ports with l′, so that the input fibers (ports) are denoted with 11-1 . . . 11-i . . . 11-l and the ***output fibers (ports)*** are denoted with 12-1, . . . 12-i′, . . . 12-l′." *See id.* at 5:34-40 (emphasis added); *see also id.* at 5:44-49, 5:67-6:4, 6:36-40, 6:42-44, Fig. 3A. Lalonde further notes that Figure 3B "shows a perspective view of a switch fabric with 3-D MEMS matrices 10 and 20, for ***switching 4-channel signals input on four fibers 11-1 to 11-4***

to output fibers 12-1 to 12-4." *See id.* at 7:8-12 (emphasis added); *see also id.* at 7:38-59, Figs. 3B, 3C.

911. Therefore, Lalonde discloses to a POSITA "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator."

(xx) *'905 Patent, [39] "The optical add-drop apparatus of claim 23, wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array"*

912. Lalonde discloses to a POSITA "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array." For example, Lalonde explains that Figures 3A, reproduced below, "shows four input wavelengths and four output wavelengths in one plane of the switch." *See id.* at 5:34-49; *see also id.* at 5:63-6:8.



913. Lalonde further explains that Figure 4A, reproduced below, shows "the collimating and focusing lenses 16 and 17, demultiplexer 40 and multiplexer 50 in the form of diffraction gratings devices, and the 3D-MEMS matrices 10 and 20," as well as "an additional diffraction grating device 14 arranged in the path of the light between the two matrices 40 and

50." *See id.* at 8:22-35. Lalonde notes that "the matrices are illustrated in the same plane." *See id.*

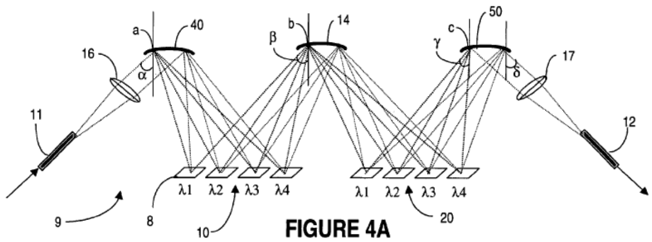


FIGURE 4A

914. Therefore, Lalonde discloses to a POSITA "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array."

(xxi) *'905 Patent, [44] "The optical add-drop apparatus of claim 23, further comprising a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels"*

915. Lalonde discloses to a POSITA "a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels." For example, Lalonde notes that "the savings in fiber management operations (footprint, power, setup time, etc) could be important." *Id.* at 3:25-27.

916. Further, Lalonde explains that "the position of the mirrors may be adjusted ***with a control system***, so that the path of a wavelength within the switch fabric is adjustable, so that a wavelength input on a port may output the switch on any port." *See id.* at Abstract (emphasis added). Lalonde provides "a photonic switch for routing a plurality of wavelengths of a DWD transport network, between a plurality of input ports and a plurality of output ports comprising, an all-optical switch fabric for cross-connecting a wavelength λ_k from an optical input multichannel signal Sin(k,i) to an optical output multichannel signal Sout(k',i'), along an adaptable optical path, and ***a control unit for configuring said adaptable optical path***." *Se id.* at

3:7-15 (emphasis added); *see also id.* at 2:48-61. With reference to Figure 2, reproduced below, Lalonde notes that "[s]witching block 8, 8' also has ***a control unit 13, 13' for controlling the path of the wavelengths*** within the switch fabric from the input ports (connectors) to the output ports, ***by adequately orienting the 3D-MEMS devices***." *See id.* at 4:61-64 (emphasis added).

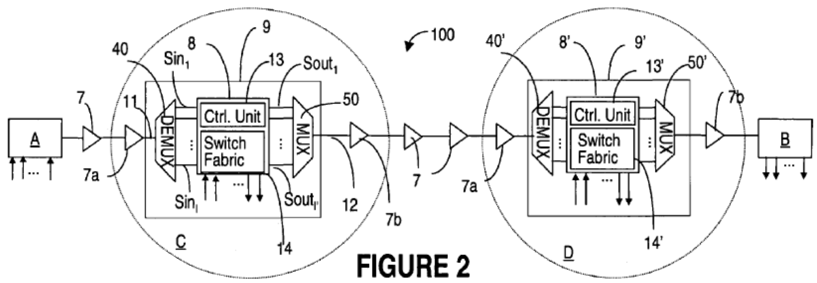
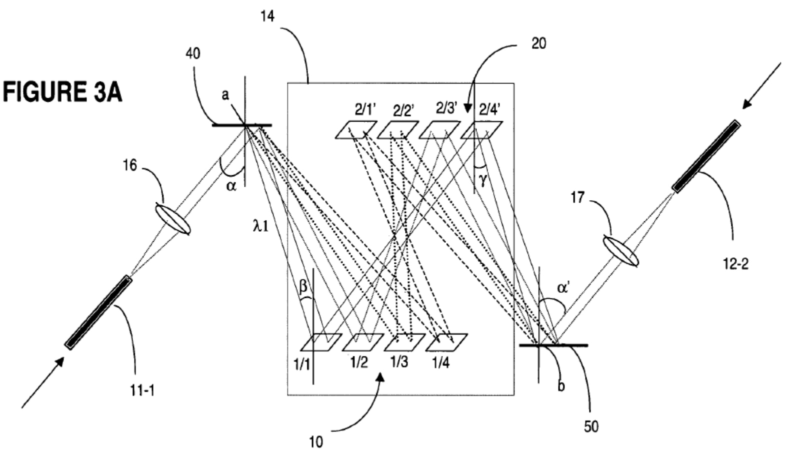


FIGURE 2

917. With reference to Figure 3A, reproduced below, Lalonde further explains:

> The diffraction grating 40 reflects each wavelength in the incoming signal Sin(4,1) on a certain 3-D MEMS device of matrix 10, at an angle of incidence β. The input fiber/port 11-1, diffraction grating 40 and matrix 10 are placed in a predetermined relationship with respect to each other by pre-setting angles α and β. The angles may be pre-set so that each wavelength input from fiber 11-i is incident on a mirror in length i, e.g. λ_1 is received on mirror 1/i, λ_2 on mirror 2/i, . . . λ_k on mirror k/i, . . . and λ_K on mirror K/i. Preferably fiber 11-1 is associated with column i=1, fiber 11-2 with column i=2, etc. In turn, the mirrors of array 10 direct the respective incident wavelength on a target mirror of MEMS matrix 20. In the example of FIG. 3A, mirror 1/1 sends λ_1 on mirror 2/1' of MEMS array 20, mirror 1/2 sends λ_2 on mirror 2/2', mirror 1/3 sends λ_3 on mirror 2/3' and mirror 1/4 sends λ_4 on mirror 2/4'. As the mirrors can rotate about two axes, each mirror can redirect wavelength λ_1 on any mirror of matrix 20 according to the position of mirror in matrix 10 its orientation (angle β). ***Angle β may be adjusted as needed by control unit 13.*** Mirrors of matrix 20 can also rotate about two axes, and each mirror is set to redirect the light towards multiplexer 50. The angle β varies with the position of the mirror in matrix 20, angle β, and the orientation of the mirror. ***The orientation of the 3-D MEMS devices in the matrix 20 is adjusted as needed by control unit 13.*** Diffraction grating 50 operates as a multiplexer, in that it combines light beams into an output multichannel signal Sout(k',i'), here Sout(4,2) according to the wavelength and the spot of incidence b, and directs signal Sout(4,2) on a respective output fiber 12. Again, the wavelength-output port-mirror assignment is preferably predetermined.

See id. at 6:9-44 (emphasis added).



918. Furthermore, Lalonde notes that "[t]he control unit . . . [is] not illustrated, for simplification" in Figures 3B and 3C, reproduced below. *See id.* at 7:8-12; *see also id.* at Figs. 3B, 3C. Similarly, the "[c]ontrol unit 13 is not illustrated for simplification in Figure 4A and 4B. *See id.* at 8:22-26; *see also id.* at 8:46-51, Figs. 4A, 4B. Lalonde explains, however, that "[f]rom matrix 10, the wavelength is reflected towards a mirror in matrix 20. The second mirror is selected in matrix 20 by the control unit 13, which adjusts the orientation β of the first mirror, according to the current wavelength map. Each mirror of matrix 20 directs the channel incident on it towards the multiplexer 50 on one of spots b-1 to b-4, depending on the β of the first mirror, the position of the second mirror in matrix 20, and the orientation γ of the second mirror. In FIG. 3B, wavelength λ_3 is reflected by mirror 3/3 on mirror 1/2', which in turn directs this wavelength on diffraction grating 50 spot b-1, for multiplexing it with other wavelengths arriving on spot b-1 and intended to travel over fiber 12-1." *See id.* at 7:34-46.

919. Therefore, Lalonde discloses to a POSITA "a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels."

(xxii) *'905 Patent, [45] "The optical add-drop apparatus of claim 44, wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port"*

920. Lalonde discloses to a POSITA "wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port." For example, Lalonde notes that "the savings in fiber management operations (footprint, power, setup time, etc) could be important." *Id.* at 3:25-27.

921. Further, Lalonde explains that "the position of the mirrors may be adjusted ***with a control system***, so that the path of a wavelength within the switch fabric is adjustable, so that a wavelength input on a port may output the switch on any port." *See id.* at Abstract (emphasis added). Lalonde provides "a photonic switch for routing a plurality of wavelengths of a DWD transport network, between a plurality of input ports and a plurality of output ports comprising, an all-optical switch fabric for cross-connecting a wavelength λ_k from an optical input multichannel signal Sin(k,i) to an optical output multichannel signal Sout(k',i'), along an adaptable optical path, and ***a control unit for configuring said adaptable optical path***." *Se id.* at 3:7-15 (emphasis added); *see also id.* at 2:48-61. With reference to Figure 2, reproduced below, Lalonde notes that "[s]witching block 8, 8' also has ***a control unit 13, 13' for controlling the path of the wavelengths*** within the switch fabric from the input ports (connectors) to the output ports, ***by adequately orienting the 3D-MEMS devices***." *See id.* at 4:61-64 (emphasis added).

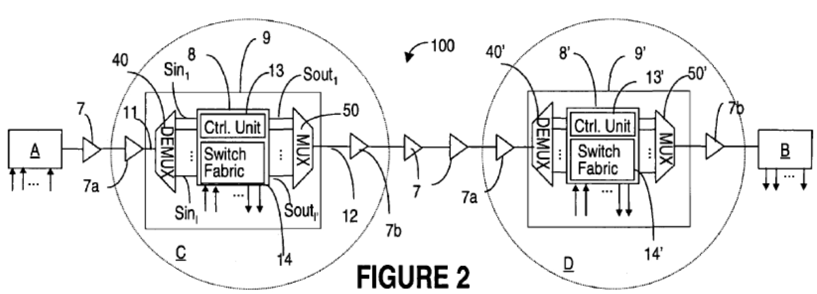
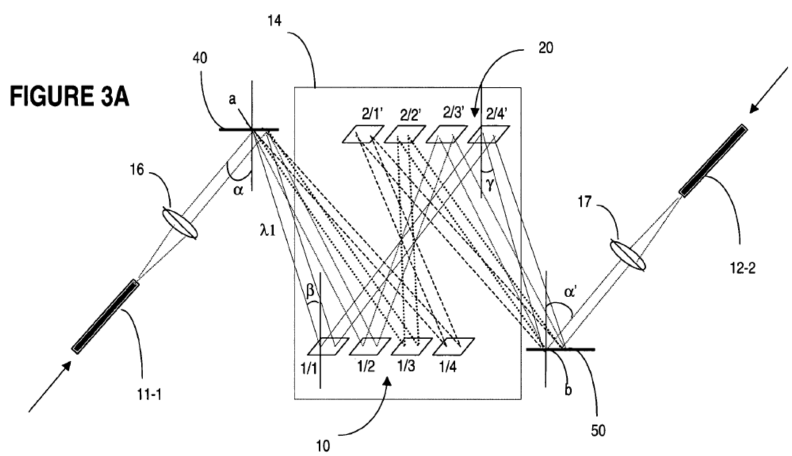


FIGURE 2

922. With reference to Figure 3A, reproduced below, Lalonde further explains:

> The diffraction grating 40 reflects each wavelength in the incoming signal Sin(4,1) on a certain 3-D MEMS device of matrix 10, at an angle of incidence β. The input fiber/port 11-1, diffraction grating 40 and matrix 10 are placed in a predetermined relationship with respect to each other by pre-setting angles α and β. The angles may be pre-set so that each wavelength input from fiber 11-i is incident on a mirror in length i, e.g. λ_1 is received on mirror 1/i, λ_2 on mirror 2/i, . . . λ_k on mirror k/i, . . . and λ_K on mirror K/i. Preferably fiber 11-1 is associated with column i=1, fiber 11-2 with column i=2, etc. In turn, the mirrors of array 10 direct the respective incident wavelength on a target mirror of MEMS matrix 20. In the example of FIG. 3A, mirror 1/1 sends λ_1 on mirror 2/1' of MEMS array 20, mirror 1/2 sends λ_2 on mirror 2/2', mirror 1/3 sends λ_3 on mirror 2/3' and mirror 1/4 sends λ_4 on mirror 2/4'. As the mirrors can rotate about two axes, each mirror can redirect wavelength λ_1 on any mirror of matrix 20 according to the position of mirror in matrix 10 its orientation (angle β). ***Angle β may be adjusted as needed by control unit 13.*** Mirrors of matrix 20 can also rotate about two axes, and each mirror is set to redirect the light towards multiplexer 50. The angle β varies with the position of the mirror in matrix 20, angle β, and the orientation of the mirror. ***The orientation of the 3-D MEMS devices in the matrix 20 is adjusted as needed by control unit 13.*** Diffraction grating 50 operates as a multiplexer, in that it combines light beams into an output multichannel signal Sout(k',i'), here Sout(4,2) according to the wavelength and the spot of incidence b, and directs signal Sout(4,2) on a respective output fiber 12. Again, the wavelength-output port-mirror assignment is preferably predetermined.

See id. at 6:9-44 (emphasis added).



923. Furthermore, Lalonde notes that "[t]he control unit . . . [is] not illustrated, for simplification" in Figures 3B and 3C, reproduced below. *See id.* at 7:8-12; *see also id.* at Figs. 3B, 3C. Similarly, the "[c]ontrol unit 13 is not illustrated for simplification in Figure 4A and

4B. *See id.* at 8:22-26; *see also id.* at 8:46-51, Figs. 4A, 4B. Lalonde explains, however, that "[f]rom matrix 10, the wavelength is reflected towards a mirror in matrix 20. The second mirror is selected in matrix 20 by the control unit 13, which adjusts the orientation β of the first mirror, according to the current wavelength map. Each mirror of matrix 20 directs the channel incident on it towards the multiplexer 50 on one of spots b-1 to b-4, depending on the β of the first mirror, the position of the second mirror in matrix 20, and the orientation γ of the second mirror. In FIG. 3B, wavelength λ_3 is reflected by mirror 3/3 on mirror 1/2', which in turn directs this wavelength on diffraction grating 50 spot b-1, for multiplexing it with other wavelengths arriving on spot b-1 and intended to travel over fiber 12-1." *See id.* at 7:34-46.

924. Therefore, Lalonde discloses to a POSITA "wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port."

(xxiii) *'905 Patent, [46] "The optical add-drop apparatus of claim 23, wherein the beam-deflecting elements are micromirrors"*

925. Lalonde discloses to a POSITA "wherein the beam-deflecting elements are micromirrors." For example, Lalonde explains that "[t]he switch fabric includes two matrices of 3-D MEMS mirrors arranged in the same plane, or in two parallel planes." *See id.* at Abstract; *see also id.* at 6:20-35, 7:13-33, 8:46-60, Figs. 3A-4B. Lalonde also notes that "MEM mirrors technology has evolved lately. The '3-D MEMS' devices have emerged as the photonic switch technology of choice for large fabric switches. ***3-D MEMS is a term used by the Applicant for a mirror mounted on a frame that can be rotated along two axes, giving it four degrees of freedom.*** The 3-D MEMS devices are arranged preferably in a matrix, which comprises besides the mirrors a control system for positioning the mirrors independently." *See id.* at 2:30-37 (emphasis added).

926. Therefore, Lalonde discloses to a POSITA "wherein the beam-deflecting elements are micromirrors."

(xxiv) *'905 Patent, [47-pre] "An optical add-drop apparatus, comprising"*

927. I previously analyzed Lalonde in view of the following limitations:

- "[a]n optical add-drop apparatus," discussed above in Section IX.1.d.ii (Paragraphs 840-845).

I incorporate that analysis by reference.

(xxv) *'905 Patent, [47-a] "a fiber collimator serving as an input port for an input multi-wavelength optical signal having multiple spectral channels"*

928. I previously analyzed Lalonde in view of the following limitations:

- "fiber collimators serving as an input port . . . ," discussed above in Section IX.1.d.ii (Paragraphs 840-845); and
- "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels[,]" discussed above in Section IX.1.d.iii (Paragraphs 846-849).

I incorporate that analysis by reference.

(xxvi) *'905 Patent, [47-b] "an output port for an output multi-wavelength optical signal"*

929. I previously analyzed Lalonde in view of the following limitations:

- "an output port . . . ," discussed above in Section IX.1.d.ii (Paragraphs 840-845); and
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.d.v (Paragraphs 855-858).

I incorporate that analysis by reference.

(xxvii) *'905 Patent, [47-c] "one or more fiber collimators serving as one or more drop ports for selected spectral channels dropped from said multi-wavelength optical signal"*

930. I previously analyzed Lalonde in view of the following limitations:

- "fiber collimators serving as . . . one or more other ports . . . ," discussed above in Section IX.1.d.ii (Paragraphs 840-845);
- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.d.xi (Paragraphs 879-884); and
- "wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.d.xv (Paragraphs 897-901).

I incorporate that analysis by reference.

(xxviii) *'905 Patent, [47-d] "a wavelength-selective device for spatially separating said multiple spectral channels"*

931. I previously analyzed Lalonde in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.d.vi (Paragraphs 859-861).

I incorporate that analysis by reference.

(xxix) *'905 Patent, [47-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports and to control the power of the spectral channel reflected to said output port of the fiber collimator serving as said selected port, whereby a subset of said spectral channels is directed to said fiber collimator serving as said drop ports"*

932. I previously analyzed Lalonde in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869);
- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.d.xi (Paragraphs 879-884); and
- "wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.d.xv (Paragraphs 897-901).

I incorporate that analysis by reference.

(xxx) *'905 Patent, [48] "The optical add-drop apparatus of claim 47, wherein none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"*

933. I previously analyzed Lalonde in view of the following limitations:

- "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]" discussed above in Section IX.1.d.xix (Paragraphs 910-911).

I incorporate that analysis by reference.

(xxxi) *'905 Patent, [49] "An optical add-drop apparatus, comprising"*

934. I previously analyzed Lalonde in view of the following limitations:

- "[a]n optical add-drop apparatus[,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845).

I incorporate that analysis by reference.

(xxxii) *'905 Patent, [49-a] "a fiber collimator serving as an input port for an input multi-wavelength optical signal having multiple spectral channels"*

935. I previously analyzed Lalonde in view of the following limitations:

- "fiber collimators serving as an input port . . . [,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845); and
- "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels[,]" discussed above in Section IX.1.d.iii (Paragraphs 846-849).

I incorporate that analysis by reference.

(xxxiii)*'905 Patent, [49-b] "an output port for an output multi-wavelength optical signal"*

936. I previously analyzed Lalonde in view of the following limitations:

- "an output port . . . ," discussed above in Section IX.1.d.ii (Paragraphs 840-845); and

- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.d.v (Paragraphs 855-858).

I incorporate that analysis by reference.

(xxxiv) *'905 Patent, [49-c] "one or more fiber collimators serving as one or more add ports for selected spectral channels to be added to said output multi-wavelength optical signal"*

937. I previously analyzed Lalonde in view of the following limitations:

- "fiber collimators serving as . . . one or more other ports . . . ," discussed above in Section IX.1.d.ii (Paragraphs 840-845);
- "direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.d.xii (Paragraphs 891-893); and
- "wherein said fiber collimator one or more other ports comprise a fiber collimator add port . . . for respectively adding second . . . spectral channels[,]" discussed above in Section IX.1.d.xv (Paragraphs 897-901).

I incorporate that analysis by reference.

(xxxv) *'905 Patent, [49-d] "a wavelength-selective device for reflecting said multiple and said selected spectral channels"*

938. I previously analyzed Lalonde in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.d.vi (Paragraphs 859-861).

I incorporate that analysis by reference.

939. Furthermore, a POSITA would understand that the wavelength-selective device can "reflect" the spectral channels. For example, Lalonde explains that "[t]he diffraction grating 40 ***reflects*** each wavelength in the incoming signal Sin(4,1) on a certain 3-D MEMS device of

matrix 10, at an angle of incidence β." *See id.* at 6:9-19 (emphasis added); *see also id.* at 5:63-67, 6:54-55, 7:23-33, 7:52-59, 8:6-14, Figs. 3A-3C.

940. Therefore, Lalonde discloses to a POSITA "a wavelength-selective device for reflecting said multiple and said selected spectral channels."

(xxxvi) *'905 Patent, [49-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports and to control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port, whereby said spectral channels from said fiber collimators serving as said add ports are selectively provided to said output port"*

941. I previously analyzed Lalonde in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869);
- "direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.d.xii (Paragraphs 891-893); and
- "wherein said fiber collimator one or more other ports comprise a fiber collimator add port . . . for respectively adding second . . . spectral channels[,]" discussed above in Section IX.1.d.xv (Paragraphs 897-901).

I incorporate that analysis by reference.

(xxxvii) *'905 Patent, [50] "The optical add-drop apparatus of claim 49, wherein none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"*

942. I previously analyzed Lalonde in view of the following limitations:

- "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]" discussed above in Section IX.1.d.xix (Paragraphs 910-911).

I incorporate that analysis by reference.

(xxxviii) *'905 Patent, [51-pre] "A method of performing dynamic add and drop in a WDM optical network, comprising"*

943. I previously analyzed Lalonde in view of the following limitations:

- "[a]n optical add-drop apparatus[,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845);
- "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.d.xi (Paragraphs 879-884); and
- "the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.d.xii (Paragraphs 891-893).

I incorporate that analysis by reference.

944. To the extent the language in the preamble is considered limiting, a POSITA would understand that the disclosed integrated photonic switch in Lalonde would also disclose

"[a] method of performing dynamic add and drop in a WDM optical network." Therefore, Lalonde discloses to a POSITA "[a] method of performing dynamic add and drop in a WDM optical network."

(xxxix) *'905 Patent, [51-a] "separating an input multi-wavelength optical signal into spectral channels"*

945. I previously analyzed Lalonde in view of the following similar limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.d.vi (Paragraphs 859-861).

I incorporate that analysis by reference.

(xl) *'905 Patent, [51-b] "imaging each of said spectral channels onto a corresponding beam-deflecting element"*

946. I previously analyzed Lalonde in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channel[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869); and
- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.d.xvi (Paragraphs 902-905).

I incorporate that analysis by reference.

(xli) *'905 Patent, [51-c] "controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal"*

947. I previously analyzed Lalonde in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output

port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869);

- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.d.viii (Paragraphs 870-873);
- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.d.ix (Paragraphs 874-877); and
- "said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal[,]" discussed above in Section IX.1.d.xiv (Paragraphs 897-901).

I incorporate that analysis by reference.

948. A POSITA would understand that the disclosed individually and continuously controllable beam-deflecting elements of Lalonde are dynamically controlled. *See* Lalonde at Abstract, 2:32-37, 2:48-3:18, 3:59-64, 4:61-5:13, 5:34-57, 5:63-6:41, 6:54-8:51, 9:4-8, Figs. 2-4B. Therefore, Lalonde discloses to a POSITA "controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal."

(xlii) *'905 Patent, [51-d] "receiving the output multi-wavelength optical signal at an output port that transmits the output multi-wavelength optical signal to an optical fiber; and wherein"*

949. I previously analyzed Lalonde in view of the following limitations:

- "an output port[,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845);
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.d.v (Paragraphs 855-858); and
- "each of said elements . . . reflect[ing] its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869).

I incorporate that analysis by reference.

950. Lalonde specifically discloses transmitting the output signal "to an output fiber." For example, Lalonde explains that "the wavelengths are then multiplexed into WDM signals directed to the appropriate output ports." *See id.* at Abstract; *see also id.* at 2:32-37, 3:16-18, 4:5-11, 4:46-51, 4:61-5:13, 5:23-28, 5:34-57, 5:67-6:4, 6:9-44, 6:54-66, 7:8-12, 7:23-59, 7:65-8:14, Figs. 1-3C. Therefore, Lalonde discloses to a POSITA "receiving the output multi-wavelength optical signal at an output port that transmits the output multi-wavelength optical signal to an optical fiber."

(xliii) *'905 Patent, [51-e] "said selected ones of said spectral channels comprises a subset of said spectral channels, such that other non-selected ones of said spectral channels are dropped from said output multi-wavelength optical signal; and"*

951. I previously analyzed Lalonde in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output

port or the fiber collimator ports[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869);

- "direct[ing] selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.d.xi (Paragraphs 879-884); and
- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.d.xv (Paragraphs 897-901).

I incorporate that analysis by reference.

(xliv) *'905 Patent, [51-f] "said controlling comprises reflecting said non-selected ones of said spectral channels to one or more fiber collimator serving as drop ports"*

952. I previously analyzed Lalonde in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.d.viii (Paragraphs 870-873);
- "direct[ing] selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.d.xi (Paragraphs 879-884); and

- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.d.xv (Paragraphs 897-901).

I incorporate that analysis by reference.

> **(xlv)** *'905 Patent, [52] "The method of claim 51 further comprising imaging other spectral channels onto other corresponding beam-deflecting elements, and controlling dynamically and continuously said other beam-deflecting elements so as to combine said other spectral channels with said selected ones of said spectral channels into said output multi-wavelength optical signal"*

953. I previously analyzed Lalonde in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.d.viii (Paragraphs 870-873);
- "direct[ing] selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.d.xii (Paragraphs 891-893);
- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.d.xv (Paragraphs 897-901); and
- "controlling dynamically . . . beam-deflecting elements[,]" discussed above in Section IX.1.d.xli (Paragraphs 949-950).

I incorporate that analysis by reference.

(xlvi) *'905 Patent, [53] "The method of claim 51, wherein said imaging comprises focusing said spectral channels onto said beam-deflecting elements"*

954. I previously analyzed Lalonde in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869); and
- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.d.xvi (Paragraphs 902-905).

I incorporate that analysis by reference.

(xlvii) *'905 Patent, [54] "The method of claim 51 further comprising monitoring a power level in one or more of said selected ones of said spectral channels, and controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring"*

955. I previously analyzed Lalonde in view of the following limitations:

- "a spectral monitor for monitoring said power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.d.ix (Paragraphs 874-877).

I incorporate that analysis by reference.

(xlviii) *'906 Patent, [68-pre] "A wavelength-separating-routing apparatus, comprising"*

956. To the extent the language in the preamble is considered limiting, Lalonde discloses to a POSITA "[a] wavelength-separating-routing apparatus." For example, Lalonde is directed to "[an] integrated photonic switch [that] can be used in all-optical networks." *See id.* at

Abstract; *see also id.* at 4:5-11, 4:46-51, 4:61-64, 5:23-28, Figs. 1, 2. Lalonde further explains that the input signal "is separated into four component wavelengths (K=4) by demultiplexer 40." *See id.* at 5:63-67; *see also id.* at 5:34-40, 5:67-6:4, 6:9-19, 6:42-44, 6:54-55, 7:8-12, 7:23-33, 7:47-59, 8:6-14, Figs. 3A-3C.

957. Therefore, Lalonde discloses to a POSITA "[a]n optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports."

(xlix) *'906 Patent, [68-a] "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports"*

958. I previously analyzed Lalonde in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845).

I incorporate that analysis by reference.

959. Figure 3B, reprinted below, further shows multiple fiber collimators, each corresponding to an input port or output.

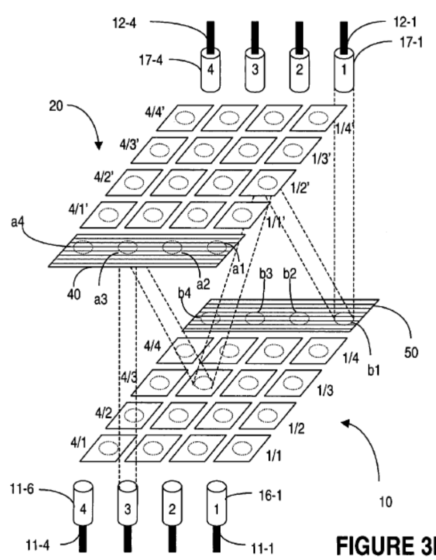


FIGURE 3B

960. Therefore, Lalonde discloses to a POSITA "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports."

(l) *'906 Patent, [68-b] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

961. I previously analyzed Lalonde in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.d.vi (Paragraphs 859-861).

I incorporate that analysis by reference.

(li) *'906 Patent, [68-c] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

962. I previously analyzed Lalonde in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.d.xvi (Paragraphs 902-905).

I incorporate that analysis by reference.

963. Lalonde further explains that "[t]he output of the photonic switch 9 is also provided with a focusing lens 17, for focusing the wavelengths form spot b on the fiber 12-2." *See id.* at 6:42-44; *see also id.* at 7:8-12, 8:27-45, 9:4-8, Figs. 3A-4A. Therefore, Lalonde discloses to a POSITA "a beam-focuser, for focusing said spectral channels into corresponding spectral spots."

(lii) *'906 Patent, [68-d] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports"*

964. I previously analyzed Lalonde in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port [,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869).

I incorporate that analysis by reference.

965. Lalonde discloses to a POSITA "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports." For example, Lalonde explains that "[i]ndividual wavelengths are switched within the switch fabric towards the desired output, and . . . [that] [t]he switch fabric includes two matrices of 3-D MEMS mirrors arranged in the same plane, or in two parallel planes." *See id.* at Abstract. Lalonde further notes that "MEM mirrors technology has evolved lately. The `3-D MEMS` devices have emerged as the photonic switch technology of choice for large fabric switches. 3-D MEMS is a term used by the Applicant for a

mirror mounted on a frame that can be ***rotated along two axes***, giving it four degrees of freedom. The 3-D MEMS devices are arranged preferably in a matrix, which comprises besides the mirrors a control system for positioning the mirrors independently." *See id.* at 2:30-37 (emphasis added); *see also id.* at 3:16-18, 4:61-64, 5:34-57, 6:9-35, 6:54-66, 7:13-42, 7:65-8:14, 8:46-60, Figs. 3A-4B.

966. Therefore, Lalonde discloses to a POSITA "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports."

(liii) *'906 Patent, [69] "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports"*

967. I previously analyzed Lalonde in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.d.ix (Paragraphs 874-877); and
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.d.xxii (Paragraphs 920-924).

I incorporate that analysis by reference.

(liv) *'906 Patent, [70] "The wavelength-separating-routing apparatus of claim 69 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

968. I previously analyzed Lalonde in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.d.ix (Paragraphs 874-877).

I incorporate that analysis by reference.

(lv) *'906 Patent, [71] "The wavelength-separating-routing apparatus of claim 70 wherein said servo-control assembly maintains said power levels at a predetermined value."*

(lvi) *To the extent Lalonde does not teach "wherein said servo-control assembly maintains said power levels at a predetermined value[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. '906 Patent, [72] "The wavelength-separating-routing apparatus of claim 68 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."*

969. I previously analyzed Lalonde in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.d.xiii (Paragraphs 891-893); and

- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.d.xlvii (Paragraph 955).

I incorporate that analysis by reference.

970. Lalonde discloses to a POSITA "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports." For example, Lalonde explains that "[t]he multiplexer and demultiplexer are diffraction grating devices, integrated with the switch fabric. The switch fabric includes two matrices of 3-D MEMS mirrors arranged in the same plane, or in two parallel planes. The optical path between the input ports, the demultiplexer and the input matrix is pre-set so that each wavelength is incident on a certain mirror. Similarly, the geometry of the output matrix, the multiplexer and the output ports determines uniquely the wavelengths on a certain port. However, the position of the mirrors may be adjusted with a control system, so that the path of a wavelength within the switch fabric is adjustable, so that a wavelength input on a port may output the switch on any port." *See id.* at Abstract; *see also id.* at 2:32-37, 3:16-18. Lalonde further explains that the "[s]witching block 8, 8′ also has a control unit 13, 13′ for controlling the path of the wavelengths within the switch fabric from the input ports (connectors) to the output ports, by adequately orienting the 3D-MEMS devices." *See id.* at 4:61-64; *see also id.* at 5:34-57.

971. Lalonde notes:

> The diffraction grating 40 reflects each wavelength in the incoming signal Sin(4,1) on a certain 3-D MEMS device of matrix 10, at an angle of incidence β.

> ***The input fiber/port 11-1, diffraction grating 40 and matrix 10 are placed in a predetermined relationship with respect to each other by pre-setting angles α and β.*** The angles may be pre-set so that each wavelength input from fiber 11-i is incident on a mirror in length i, e.g. λ1 is received on mirror 1/i, λ2 on mirror 2/i, . . . λ_k on mirror k/i, . . . and λ_K on mirror K/i. Preferably fiber 11-1 is associated with column i=1, fiber 11-2 with column i=2, etc. In turn, ***the mirrors of array 10 direct the respective incident wavelength on a target mirror of MEMS matrix 20.*** In the example of FIG. 3A, mirror 1/1 sends λ1 on mirror 2/1′ of MEMS array 20, mirror 1/2 sends λ2 on mirror 2/2′, mirror 1/3 sends λ3 on mirror 2/3′ and mirror 1/4 sends λ4 on mirror 2/4′. As the mirrors can rotate about two axes, ***each mirror can redirect wavelength λ1 on any mirror of matrix 20 according to the position of mirror in matrix 10 its orientation (angle β).*** Angle β may be adjusted as needed by control unit 13. ***Mirrors of matrix 20 can also rotate about two axes, and each mirror is set to redirect the light towards multiplexer 50.*** The angle β varies with the position of the mirror in matrix 20, angle β, and the orientation of the mirror. The orientation of the 3-D MEMS devices in the matrix 20 is adjusted as needed by control unit 13.

See id. at 6:9-35 (emphasis added); *see also id.* at 6:54-66, 7:23-42, 7:65-8:14, Figs. 3A-3C.

972. Therefore, Lalonde discloses to a POSITA "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."

(lvii) *'906 Patent, [79] "The wavelength-separating-routing apparatus of claim 68 wherein each channel micromirror is a silicon micromachined mirror."*

973. Lalonde discloses to a POSITA "wherein each channel micromirror is a silicon micromachined mirror." Further, to the extent Lalonde does not teach that each micromachined mirror is "silicon," this limitation would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

974. Lalonde explains that "[t]he switch fabric includes two matrices of 3-D MEMS mirrors arranged in the same plane, or in two parallel planes." *See id.* at Abstract; *see also id.* at 6:20-35, 7:13-33, 8:46-60, Figs. 3A-4B. Lalonde also notes that "MEM mirrors technology has

evolved lately. The '3-D MEMS' devices have emerged as the photonic switch technology of choice for large fabric switches. ***3-D MEMS is a term used by the Applicant for a mirror mounted on a frame that can be rotated along two axes, giving it four degrees of freedom.*** The 3-D MEMS devices are arranged preferably in a matrix, which comprises besides the mirrors a control system for positioning the mirrors independently." *See id.* at 2:30-37 (emphasis added).

975. Therefore, Lalonde discloses to a POSITA "wherein each channel micromirror is a silicon micromachined mirror." Further, to the extent Lalonde does not teach that each micromachined mirror is "silicon," this limitation would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lviii) *'906 Patent, [80] "The wavelength-separating-routing apparatus of claim 68 wherein said fiber collimator input and output ports are arranged in a one-dimensional array."*

976. I previously analyzed Lalonde in view of the following limitations:

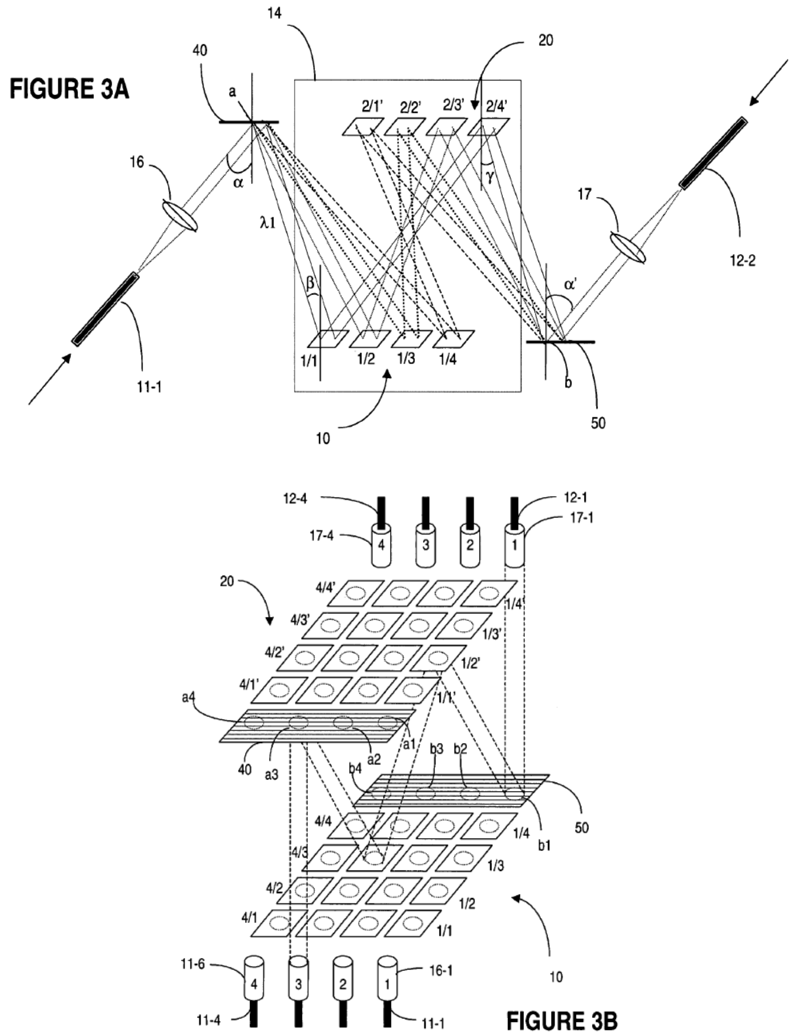
- "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array[,]"discussed above in Section IX.1.d.xx (Paragraphs 912-914).

I incorporate that analysis by reference.

(lix) *'906 Patent, [81] "The wavelength-separating-routing apparatus of claim 68 wherein said beam-focuser comprises a focusing lens having first and second focal points."*

977. Lalonde discloses to a POSITA "wherein said beam-focuser comprises a focusing lens having first and second focal points." For example, Lalonde explains that "[f]iber 11-1, as well as all remaining input fibers, is aligned to direct the incoming light on collimating lens 16, which in turn directs the wavelengths on diffraction grating 40 on a certain area (spot) noted

with a, and at an angle of incidence α. The term spot is used herein to define the area of incidence of a beam of light, as shown in FIG. 3A by letters a and b, and as intuitively shown for example in FIG. 3B by dotted circles marked a1 to a4 and by to b4." *See id.* at 5:63-6:8; *see also id.* at 7:8-12, Figs. 3A-3C. Figures 3A and 3B are reproduced below.



978. Lalonde further explains that "[t]he output of the photonic switch 9 is also provided with a focusing lens 17, for focusing the wavelengths form spot b on the fiber 12-2." *See id.* at 6:42-44. Lalonde also notes that "[d]evice 50 reflects the light incident on it at an output angle δ to focusing lens 17-3, and from there to output fiber 12-3. In the example of FIG.

3B, wavelength λ_3 is combined with λ_1 by device 50, as these wavelengths are directed by the respective mirrors in matrix 20 onto fiber 12-3.” *See id.* at 9:4-8.

979. Lalonde further explains:

> The diagram of FIGS. 4A and 4B show optical elements similar to those in FIG. 3A, namely the collimating and focusing lenses 16 and 17, demultiplexer 40 and multiplexer 50 in the form of diffraction gratings devices, and the 3D-MEMS matrices 10 and 20. This embodiment comprises an additional diffraction grating device 14 arranged in the path of the light between the two matrices 40 and 50. Although the matrices are illustrated in the same plane, it is apparent that they need not necessarily be co-planar. In this example there are eight input fibers 11-1 to 11-8 and eight output fibers 12-1 to 12-8 (l=l'=8), each carrying four channels λ_1 to λ_4 (k=4). An input signal Sin(k,i) from an input fiber 11-i is collimated with the respective lenses 16-1 to 16-8, while an output signal Sout(k',i') is focussed on the output fibers 12-1 to 12-8 by focusing lens 17-1 to 17-8. It is to be understood that the number of fibers and of wavelengths are by way of example only, and that the photonic switch can cross-connect a much larger number of wavelengths between a larger number of fibers.

See id. at 8:27-45; *see also id.* at Figs. 4A, 4B.

980. A POSITA would understand that the disclosed focusing lens would have first and second focal points. Therefore, Lalonde discloses to a POSITA “wherein said beam-focuser comprises a focusing lens having first and second focal points.” Even if Lalonde does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lx) *’906 Patent, [82] “The wavelength-separating-routing apparatus of claim 81 wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens.”*

981. To the extent Lalonde does not disclose “wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens[,]”these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxi) *'906 Patent, [83] "The wavelength-separating-routing apparatus of claim 68 wherein said beam-focuser comprises an assembly of lenses."*

982. To the extent Lalonde does not disclose "wherein said beam-focuser comprises an assembly of lenses[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxii) *'906 Patent, [84] "The wavelength-separating-routing apparatus of claim 68 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing gratings."*

983. I previously analyzed Lalonde in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.d.xvii (Paragraphs 906-907).

I incorporate that analysis by reference.

(lxiii) *'906 Patent, [85] "The wavelength-separating-routing apparatus of claim 68 further comprising a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors."*

984. To the extent Lalonde does not teach "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxiv) *'906 Patent, [86] "The wavelength-separating-routing apparatus of claim 68 wherein each fiber collimator output port carries a single one of said spectral channels."*

985. Lalonde discloses to a POSITA "wherein each fiber collimator output port carries a single one of said spectral channels." For example, Lalonde explains that "[i]ndividual wavelengths are switched within the switch fabric towards the desired output, and the wavelengths are then multiplexed into WDM signals directed to the appropriate output ports." *See id.* at Abstract; *see also id.* at 3:7-14, 4:61-64, 6:20-35, 7:8-12, Figs. 2-3C. Lalonde further explains that "wavelength λ_3 is reflected by mirror 3/3 on mirror 1/2', which in turn directs this wavelength on diffraction grating 50 spot b-1, for multiplexing it with other wavelengths arriving on spot b-1 and intended to travel over fiber 12-1." *See id.* at 7:34-46; *see also id.* at 8:22-26, Figs. 3B, 4A, 4B.

986. A POSITA would understand that each individual wavelength could be sent to a corresponding output port, *e.g.*, if the wavelength was not multiplexed with any other wavelengths. Therefore, Lalonde discloses to a POSITA "wherein each fiber collimator output port carries a single one of said spectral channels."

(lxv) *'906 Patent, [87] "The wavelength-separating-routing apparatus of claim 86 further comprising one or more optical sensors, optically coupled to said fiber collimator output ports."*

987. Lalonde discloses to a POSITA "one or more optical sensors, optically coupled to said fiber collimator output ports." For example, Lalonde explains that "[i]ndividual wavelengths are switched within the switch fabric towards the desired output, and the wavelengths are then multiplexed into WDM signals directed to the appropriate output ports." *See id.* at Abstract; *see also id.* at 3:7-14, 4:61-64, 6:20-35, 7:8-12, Figs. 2-3C. Lalonde further explains that "wavelength λ_3 is reflected by mirror 3/3 on mirror 1/2', which in turn directs this wavelength on diffraction grating 50 spot b-1, for multiplexing it with other wavelengths

arriving on spot b-1 and intended to travel over fiber 12-1." *See id.* at 7:34-46; *see also id.* at 8:22-26, Figs. 3B, 4A, 4B.

988. A POSITA would understand that optical sensors could be optically coupled to the fiber collimator output ports. Therefore, Lalonde discloses to a POSITA "one or more optical sensors, optically coupled to said fiber collimator output ports." Even if Lalonde does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxvi) *'906 Patent, [88] "The wavelength-separating-routing apparatus of claim 68, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator."*

989. I previously analyzed Lalonde in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.d.xix (Paragraphs 910-911).

I incorporate that analysis by reference.

(lxvii) *'906 Patent, [89-pre] "A servo-based optical apparatus comprising"*

990. I previously analyzed Lalonde in view of the following limitations:

- "An optical . . . apparatus[,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.d.viii (Paragraphs 870-873); and
- "wherein the control unit further comprises a servo-control assembly[,]" discussed above in Section IX.1.d.ix (Paragraphs 874-877).

I incorporate that analysis by reference.

(lxviii) *'906 Patent, [89-a] "multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports"*

991. I previously analyzed Lalonde in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845); and
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports [,]" discussed above in Section IX.1.d.xlix (Paragraphs 958-960).

I incorporate that analysis by reference.

(lxix) *'906 Patent, [89-b] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

992. I previously analyzed Lalonde in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.d.vi (Paragraphs 859-861).

I incorporate that analysis by reference.

(lxx) *'906 Patent, [89-c] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

993. I previously analyzed Lalonde in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.d.xvi (Paragraphs 902-905); and
- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.d.li (Paragraphs 962-963).

I incorporate that analysis by reference.

(lxxi) *'906 Patent, [89-d] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said fiber collimator output ports"*

994. I previously analyzed Lalonde in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.d.lii (Paragraphs 964-966).

I incorporate that analysis by reference.

(lxxii) *'906 Patent, [89-e] "a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports."*

995. I previously analyzed Lalonde in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power

levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.d.ix (Paragraphs 874-877);

- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.d.xxii (Paragraphs 920-924); and
- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.d.liii (Paragraph 967).

I incorporate that analysis by reference.

(lxxiii) *'906 Patent, [90] "The servo-based optical apparatus of claim 89 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

996. I previously analyzed Lalonde in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.d.ix (Paragraphs 874-877); and
- "said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors[,]" discussed above in Section IX.1.d.liv (Paragraph 968).

I incorporate that analysis by reference.

> **(lxxiv)** *'906 Patent, [91] "The servo-based optical apparatus of claim 90 wherein said servo-control assembly maintains said power levels at a predetermined value"*

997. To the extent Lalonde does not teach "wherein said servo-control assembly maintains said power levels at a predetermined value[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.'906 Patent.

> **(lxxv)** *[92] "The servo-based optical apparatus of claim 89 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."*

998. I previously analyzed Lalonde in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.d.xiii (Paragraphs 891-893);
- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.d.xlvii (Paragraph 955); and
- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.d.lvi (Paragraphs 969-972)

I incorporate that analysis by reference.

(lxxvi) *’906 Patent, [96] “The servo-based optical apparatus of claim 89 wherein each channel micromirror is a silicon micromachined mirror.”*

999. I previously analyzed Lalonde in view of the following limitations:

- “each channel micromirror is a silicon micromachined mirror[,]”discussed above in Section IX.1.d.lvii (Paragraphs 973-975).

I incorporate that analysis by reference.

(lxxvii) *’906 Patent, [97] “The servo-based optical apparatus of claim 89 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms.”*

1000. I previously analyzed Lalonde in view of the following limitations:

- “wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]”discussed above in Section IX.1.d.xvii (Paragraphs 906-907).

I incorporate that analysis by reference.

(lxxviii) *’906 Patent, [98] “The servo-based optical apparatus of claim 89 wherein said beam-focuser comprises one or more lenses.”*

1001. I previously analyzed Lalonde in view of the following limitations:

- “wherein said beam-focuser comprises an assembly of lenses [,]”discussed above in Section IX.1.d.lxi (Paragraph 982).

I incorporate that analysis by reference.

(lxxix) *’906 Patent, [99] “The servo-based optical apparatus of claim 89, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator”*

1002. I previously analyzed Lalonde in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.d.xix (Paragraphs 910-911).

I incorporate that analysis by reference.

(lxxx) *'906 Patent, [100-pre] "An optical apparatus comprising:"*

1003. I previously analyzed Lalonde in view of the following limitations:

- "An optical . . . apparatus[,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845).

I incorporate that analysis by reference.

(lxxxi) *'906 Patent, [100-a] "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal"*

1004. I previously analyzed Lalonde in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845); and
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports [,]" discussed above in Section IX.1.d.xlix (Paragraphs 958-960).

I incorporate that analysis by reference.

1005. Lalonde discloses to a POSITA "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal." For example, Lalonde explains that "[t]he input span 11 and output span 12 in FIG. 2 comprise a plurality of input and output fibers." *See id.* at 4:65-5:13; *see also id.* at Fig. 2.

1006. Therefore, Lalonde discloses to a POSITA "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal."

(lxxxii) *'906 Patent, [100-b] "a plurality of output ports"*

1007. I previously analyzed Lalonde in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845).

I incorporate that analysis by reference.

(lxxxiii) *'906 Patent, [100-c] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

1008. I previously analyzed Lalonde in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.d.vi (Paragraphs 859-861).

I incorporate that analysis by reference.

(lxxxiv) *'906 Patent, [100-d] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

1009. I previously analyzed Lalonde in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.d.xvi (Paragraphs 902-905); and
- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.d.li (Paragraphs 962-963).

I incorporate that analysis by reference.

(lxxxv) *'906 Patent, [100-e] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually and continuously controllable to reflect said spectral channels into selected ones of said output ports"*

1010. I previously analyzed Lalonde in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.d.lii (Paragraphs 964-966).

I incorporate that analysis by reference.

(lxxxvi) *'906 Patent, [100-f] "a one-dimensional array of collimator-alignment mirrors, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports"*

1011. I previously analyzed Lalonde in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.d.xiii (Paragraphs 891-893);
- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.d.xlvii (Paragraph 955); and

- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.d.lvi (Paragraphs 969-972)

I incorporate that analysis by reference.

1012. A POSITA would understand that an array of collimator-alignment mirrors includes a one-dimensional array. Therefore, Lalonde discloses to a POSITA "a one-dimensional array of collimator-alignment mirrors, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports."

(lxxxvii) *'906 Patent, [106] "The optical apparatus of claim 100, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"*

1013. I previously analyzed Lalonde in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.d.xix (Paragraphs 910-911).

I incorporate that analysis by reference.

(lxxxviii) *'906 Patent, [115-pre] "An optical system comprising a wavelength-separating-routing apparatus, wherein said wavelength-separating-routing apparatus includes"*

1014. I previously analyzed Lalonde in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]" discussed above in Section IX.1.d.xlviii (Paragraphs 956-957).

I incorporate that analysis by reference.

1015. To the extent the language in the preamble is considered limiting, a POSITA would understand that the disclosed integrated photonic switch in Lalonde would also disclose "[a]n optical system comprising a wavelength-separating-routing apparatus." Therefore, Lalonde discloses to a POSITA "[a]n optical system comprising a wavelength-separating-routing apparatus."

(lxxxix) *'906 Patent, [115-a] "an array of fiber collimators, providing and serving as an input port for a multi-wavelength optical signal"*

1016. I previously analyzed Lalonde in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845);
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.d.xlix (Paragraphs 958-960); and
- "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal[,]" discussed above in Section IX.1.d.lxxxi (Paragraphs 1003-1005).

I incorporate that analysis by reference.

(xc) *'906 Patent, [115-b] "a plurality of output ports including a pass-through port and one or more drop ports"*

1017. I previously analyzed Lalonde in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845); and

- "wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.d.xv (Paragraphs 897-901).

I incorporate that analysis by reference.

1018. To the extent Lalonde does not teach "a pass-through port," this limitation would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xci) *'906 Patent, [115-c] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

1019. I previously analyzed Lalonde in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.d.vi (Paragraphs 859-861).

I incorporate that analysis by reference.

(xcii) *'906 Patent, [115-d] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

1020. I previously analyzed Lalonde in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.d.xvi (Paragraphs 902-905); and
- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.d.li (Paragraphs 962-963).

I incorporate that analysis by reference.

(xciii) *'906 Patent, [115-e] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels."*

1021. I previously analyzed Lalonde in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.d.lii (Paragraphs 964-966).

I incorporate that analysis by reference.

1022. To the extent Lalonde does not teach "whereby said fiber collimator pass-through port receives a subset of said spectral channels," this limitation would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xciv) *'906 Patent, [116] "The optical system of claim 115 further comprising a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports"*

1023. I previously analyzed Lalonde in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.d.ix (Paragraphs 874-877);
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.d.xxii (Paragraphs 920-924); and
- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.d.liii (Paragraph 967).

I incorporate that analysis by reference.

(xcv) *'906 Patent, [117] "The optical system of claim 116 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

1024. I previously analyzed Lalonde in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power

levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.d.ix (Paragraphs 874-877); and

- "said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors[,]" discussed above in Section IX.1.d.liv (Paragraph 968).

I incorporate that analysis by reference.

(xcvi) *'906 Patent, [118] "The optical system of claim 115 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimators, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports."*

1025. I previously analyzed Lalonde in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.d.xiii (Paragraphs 891-893);
- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.d.xlvii (Paragraph 955); and
- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.d.lvi (Paragraphs 969-972).

I incorporate that analysis by reference.

(xcvii) *'906 Patent, [122] "The optical system of claim 115 wherein each channel micromirror is a silicon micromachined mirror."*

1026. I previously analyzed Lalonde in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.d.lvii (Paragraphs 973-975).

I incorporate that analysis by reference.

(xcviii) *'906 Patent, [123] "The optical system of claim 115 wherein said beam-focuser comprises a focusing lens having first and second focal points, and wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points"*

1027. I previously analyzed Lalonde in view of the following limitations:

- "wherein said beam-focuser comprises a focusing lens having first and second focal points[,]"discussed above in Section IX.1.d.lix (Paragraphs 977-980).

I incorporate that analysis by reference.

(xcix) *'906 Patent, [124] "The optical system of claim 115 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

1028. I previously analyzed Lalonde in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.d.xvii (Paragraphs 906-907).

I incorporate that analysis by reference.

(c) *'906 Patent, [125] "The optical system of claim 115 further comprising a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors"*

1029. To the extent Lalonde does not teach "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(ci) *'906 Patent, [126-pre] "The optical system of claim 115 further comprising an auxiliary wavelength-separating-routing apparatus, including:"*

1030. I previously analyzed Lalonde in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]"discussed above in Section IX.1.d.xlviii (Paragraphs 956-957); and
- "An optical system comprising a wavelength-separating-routing apparatus, wherein said wavelength-separating-routing apparatus includes[,]" discussed above in Section IX.1.d.lxxxviii (Paragraphs 1013-1014).

I incorporate that analysis by reference.

1031. To the extent the language in the preamble is considered limiting, a POSITA would understand that the disclosed wavelength-separating-routing apparatus in Lalonde could also be used as "an auxiliary wavelength-separating-routing apparatus." Therefore, Lalonde discloses to a POSITA "an auxiliary wavelength-separating-routing apparatus."

(cii) *'906 Patent, [126-a] "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports"*

1032. I previously analyzed Lalonde in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845);

- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.d.xlix (Paragraphs 958-960);
- "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal[,]" discussed above in Section IX.1.d.lxxxi (Paragraphs 1003-1005); and
- "an array of fiber collimators, providing and serving as an input port for a multi-wavelength optical signal[,]" discussed above in Section IX.1.d.lxxxix (Paragraph 1015).

I incorporate that analysis by reference.

1033. A POSITA would understand that the disclosed fiber collimators in Lalonde could be used as "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports."

(ciii) *'906 Patent, [126-b] "an exiting port"*

1034. I previously analyzed Lalonde in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845).

I incorporate that analysis by reference.

1035. A POSITA would understand that "an exiting port" is "an output port." Therefore, Lalonde discloses to a POSITA "an exiting port."

(civ) *'906 Patent, [126-c] "an auxiliary wavelength-separator"*

1036. I previously analyzed Lalonde in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.d.vi (Paragraphs 859-861).

I incorporate that analysis by reference.

1037. A POSITA would understand that the disclosed wavelength-separator in Lalonde could be used as "an auxiliary wavelength-separator."

(cv) *'906 Patent, [126-d] "an auxiliary beam-focuser"*

1038. I previously analyzed Lalonde in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.d.xvi (Paragraphs 902-905); and
- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.d.li (Paragraphs 962-963).

I incorporate that analysis by reference.

1039. A POSITA would understand that the disclosed beam-focuser in Lalonde could be used as "an auxiliary beam-focuser."

(cvi) *'906 Patent, [126-e] "a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors"*

1040. I previously analyzed Lalonde in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control

the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869);

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.d.lii (Paragraphs 964-966); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels[,]" discussed in Section IX.1.d.xciii (Paragraphs 1020-1021).

I incorporate that analysis by reference.

1041. A POSITA would understand that the disclosed spatial array of channel micromirrors in Lalonde could be used as "a spatial array of auxiliary channel micromirrors."

(cvii) *'906 Patent, [127] "The optical system of claim 126 wherein said auxiliary channel micromirrors are individually pivotable."*

1042. Lalonde discloses to a POSITA "wherein said auxiliary channel micromirrors are individually pivotable." For example, Lalonde explains that "[t]he 3-D MEMS devices are

arranged preferably in a matrix, which comprises besides the mirrors ***a control system for positioning the mirrors independently***." *See id.* at 2:30-37 (emphasis added); *see also id.* at Abstract, 3:16-18, 4:61-64, 5:34-57, 6:9-35, 6:54-66, 7:13-42, 7:65-8:14, 8:46-60, Figs. 3A-4B.

1043. Therefore, Lalonde discloses to a POSITA "wherein said auxiliary channel micromirrors are individually pivotable."

> **(cviii)** *'906 Patent, [129] "The optical system of claim 126 wherein each auxiliary channel micromirror is a silicon micromachined mirror"*

1044. I previously analyzed Lalonde in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.d.lvii (Paragraphs 973-975).

1045. I incorporate that analysis by reference.

> **(cix)** *'906 Patent, [130] "The optical system of claim 126 wherein said auxiliary wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

1046. I previously analyzed Lalonde in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.d.xvii (Paragraphs 906-907).

1047. I incorporate that analysis by reference.

(cx) *'906 Patent, [131] "The optical system of claim 126 wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports."*

1048. To the extent Lalonde does not teach "wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cxi) *'906 Patent, [132] "The optical system of claim 115, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator."*

1049. I previously analyzed Lalonde in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.d.xix (Paragraphs 910-911).

I incorporate that analysis by reference.

(cxii) *'906 Patent, [133] "A method of performing dynamic wavelength separating and routing, comprising"*

1050. I previously analyzed Lalonde in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]"discussed above in Section IX.1.d.xlviii (Paragraphs 956-957).

I incorporate that analysis by reference.

1051. To the extent the language in the preamble is considered limiting, a POSITA would understand that the disclosed integrated photonic switch in Lalonde would also disclose "[a] method of performing dynamic wavelength separating and routing." Therefore, Lalonde discloses to a POSITA "[a] method of performing dynamic wavelength separating and routing."

(cxiii) *'906 Patent, [133-a] "receiving a multi-wavelength optical signal from a fiber collimator input port"*

1052. I previously analyzed Lalonde in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.d.ii (Paragraphs 840-845); and
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.d.xlix (Paragraphs 958-960).

I incorporate that analysis by reference.

(cxiv) *'906 Patent, [133-b] "separating said multi-wavelength optical signal into multiple spectral channels"*

1053. I previously analyzed Lalonde in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.d.vi (Paragraphs 859-861).

I incorporate that analysis by reference.

(cxv) *'906 Patent, [133-c] "focusing said spectral channels onto a spatial array of corresponding beam-deflecting elements, whereby each beam-deflecting element receives one of said spectral channels"*

1054. I previously analyzed Lalonde in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.d.xvi (Paragraphs 902-905); and
- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels," discussed above in Section IX.1.d.vii (Paragraphs 862-869)

I incorporate that analysis by reference.

(cxvi) *'906 Patent, [133-d] "dynamically and continuously controlling said beam-deflecting elements in two dimensions to direct said spectral channels into any selected ones of output ports and to control the power of the spectral channels coupled into said selected output ports"*

1055. I previously analyzed Lalonde in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.d.viii (Paragraphs 870-873);
- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.d.ix (Paragraphs 874-877);
- "said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal[,]" discussed above in Section IX.1.d.xiv (Paragraphs 897-901);
- "controlling dynamically and continuously said beam-deflecting elements in two dimensions[,]"discussed above in Section IX.1.d.xli (Paragraphs 949-950);
- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral

channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port [,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.d.lii (Paragraphs 964-966).

I incorporate that analysis by reference.

(cxvii) *'906 Patent, [134] "The method of claim 133 further comprising the step of providing feedback control of said beam-deflecting elements to maintain a predetermining coupling of each spectral channel directed into one of said output ports."*

1056. I previously analyzed Lalonde in view of the following limitations:

- "a spatial array of beam-deflecting elements[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869);
- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.d.ix (Paragraphs 874-877);
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.d.xxii (Paragraphs 920-924); and
- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber

collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.d.liii (Paragraph 967).

I incorporate that analysis by reference.

(cxviii) *'906 Patent, [135] "The method of claim 134 further comprising the step of maintaining power levels of said spectral channels directed into said output ports at a predetermining value."*

1057. I previously analyzed Lalonde in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.d.ix (Paragraphs 874-877).

I incorporate that analysis by reference.

(cxix) *'906 Patent, [137] "The method of claim 133 wherein a subset of said spectral channels is directed into one of said output ports, thereby providing one or more pass-through spectral channels."*

1058. I previously analyzed Lalonde in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.d.vii (Paragraphs 862-869);
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about

two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.d.lii (Paragraphs 964-966); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels[,]"discussed above in Section IX.1.d.xciii (Paragraphs 1020-1021).

I incorporate that analysis by reference.

(cxx) *'906 Patent, [138] "The method of claim 137 further comprising the step of multiplexing said pass-through spectral channels with one or more add spectral channels, so as to provide an output optical signal."*

1059. I previously analyzed Lalonde in view of the following limitations:

- "wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors [,]"discussed above in Section IX.1.d.cvi (Paragraphs 1039-1040).

I incorporate that analysis by reference.

(cxxi) *'906 Patent, [139] "The method of claim 133 wherein said beam-deflecting elements comprise an array of silicon micromachined mirrors."*

1060. I previously analyzed Lalonde in view of the following limitations:

- "a spatial array of beam-deflecting elements[,]"discussed above in Section IX.1.d.vii (Paragraphs 862-869);
- "a spatial array of channel micromirrors[,] discussed above in Section IX.1.d.lii (Paragraphs 964-966); and
- "wherein each channel micromirror is a silicon micromachined mirror[,]" discussed above in Section IX.1.d.lvii (Paragraphs 973-975).

I incorporate that analysis by reference.

e) U.S. Patent No. 6,625,340 ("Sparks")

1061. Sparks is directed to an "optical switch [that] is arranged to misalign the optical beam path so as to provide a predetermined optical output power" Sparks at Abstract. Sparks can control mirrors to deliberately misalign an optical beam path, thus attenuating the beam as it passes through the switch due to a reduction in the power of the beam coupled into the output fibre." Sparks at 4:48-58. As shown in Figures 3a, 3b, and 4, "[t]he lines 30a and 30b represent the two extremes of the beam width, with the arrows indicating the beam direction. FIG. 3b shows how such a beam could be attenuated" by misaligning the incoming beam "so that only part of the beam profile is reflected from the mirror" Sparks at 5:12-25.

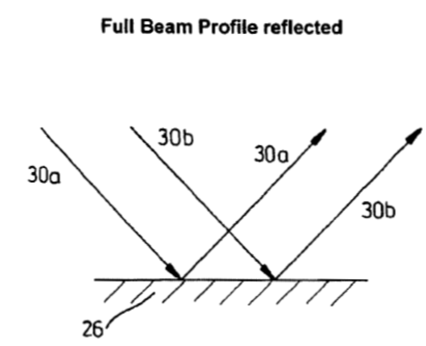


Fig. 3a

Sparks at FIG. 3A.

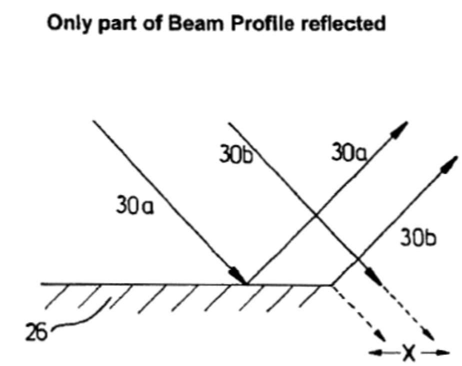


Fig. 3b

Sparks at FIG. 3B.

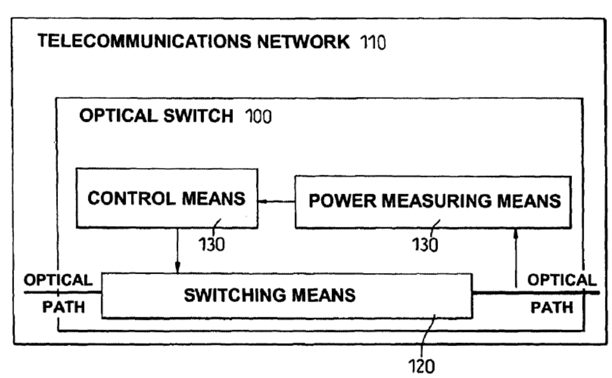


Fig. 4

Sparks at FIG. 4.

(i) Sparks *Is Prior Art to the Asserted Claims*

1062. Sparks claims priority to Application No. 09/474,544 filed on December 29, 1999, and issued on September 23, 2003. Accordingly, Sparks is prior art to the ’905 and ’906 Patents under at least pre-AIA 35 U.S.C. § 102(e).

1063. Accordingly, it is my understanding that Sparks is prior art to the ’905 and ’906 Patents under at least pre-AIA 35 U.S.C. § 102(e).

(ii) *’905 Patent, [23-pre]: “An optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports, the apparatus comprising”*

1064. To the extent the language in the preamble is considered limiting, Sparks discloses to a POSITA “[a]n optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports.”

1065. Sparks discloses light being optically connected between two transmission fibres. As shown in Figure 1, “[t]o make an optical connection between modules 10,20, the movable mirror 16 directs the beam at the movable mirror 26 of a targeted second module 20. At the same time the movable mirror 26 of the second module 20 is controlled to deflect the beam 30 towards the fixed mirror 24, into the lens 22 and hence into the fibre 4 completing the connection. It is the co-ordinated control of deflection angles by the two movable mirrors 16,26 that creates the optical connection between two transmission fibres 2,4.” Sparks at 4:24-32; *see also id.* at 4:15-20 (“Light from a fibre 2 passes through a focussing lens 12. The light which forms the beam is reflected off a fixed mirror 14 to keep device packaging small.”).

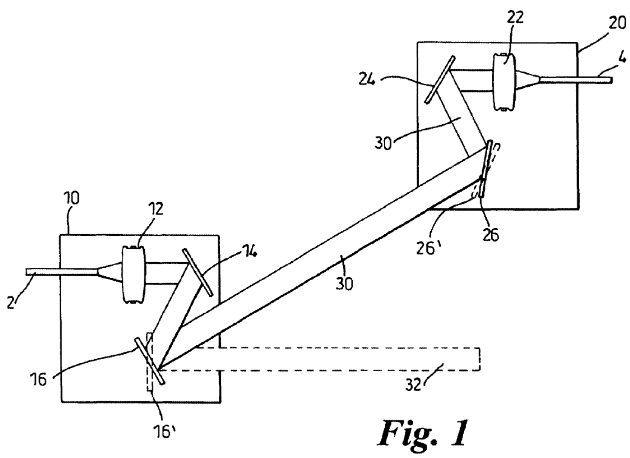


Fig. 1

Sparks at FIG. 1. There can be light coming in from any of a multiple set of fibers in an array. "By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array." Sparks at 4:33-35.

1066. Sparks also discloses the input fiber collimating the beam. As shown in Figure 3a, lines 30a and 30b, which run parallel to one another, indicate the beam direction. Sparks at 5:12-25. Having the ends of the beam defined by parallel lines 30a and 30b, it stands to reason that the input beam is collimated. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

Full Beam Profile reflected

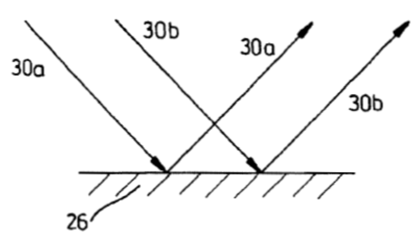


Fig. 3a

Sparks at FIG. 3A.

1067. Therefore, under Capella's apparent interpretation, Sparks discloses to a POSITA "[a]n optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(iii) *'905 Patent, [23-a] "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels"*

1068. Under Capella's apparent interpretation, Sparks discloses to a POSITA "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels."

1069. Sparks discloses at least a first channel of light being input into the optical switch from an input fiber. "FIG. 1 shows the optical path which represents a connection between the two modules 10, 20. Light from a fibre 2 passes through a focussing lens 12." Sparks at 4:15-20.

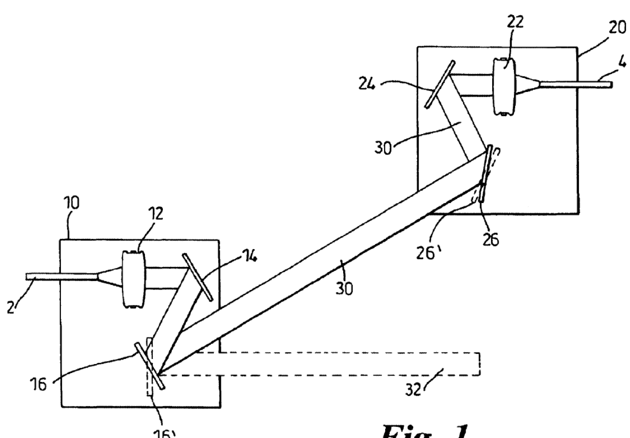


Fig. 1

Sparks at FIG. 1. Further, Sparks discloses the light beam having multiple channels. "If the optical system is being used as part of a WDM system, it is typical for the signal to be demultiplexed into the separate optical channels prior to input to the switch. If desired, each of

the channels passing through the switch may be attenuated to whatever degree necessary to achieve the desired effect, e.g. equalisation of optical power across all channels. If the signal is demultiplexed into groups of channels, equalisation of power could also be applied to these groups of wavelengths." Sparks at 2:30-38. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

1070. Therefore, under Capella's apparent interpretation, Sparks discloses to a POSITA "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(iv) *'905 Patent, [23-b] "the fiber collimator one or more other ports for second spectral channels"*

1071. Under Capella's apparent interpretation, Sparks discloses to a POSITA "the fiber collimator one or more other ports for second spectral channels."

1072. Sparks discloses having multiple arrays for modules. "By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array." Sparks at 4:33-35. Each module in the array can take on a different channel. "If the optical system is being used as part of a WDM system, it is typical for the signal to be demultiplexed into the separate optical channels prior to input to the switch. If desired, each of the channels passing through the switch may be attenuated to whatever degree necessary to achieve the desired effect, e.g. equalisation of optical power across all channels. If the signal is demultiplexed into groups of channels, equalisation of power could also be applied to these groups of wavelengths." Sparks at 2:30-38; *see also id.* at 2:66-3:2 ("Preferably, said

optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals.").

1073. Therefore, under Capella's apparent interpretation, Sparks discloses to a POSITA "the fiber collimator one or more other ports for second spectral channels." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(v) *'905 Patent, [23-c] "the output port for an output multi-wavelength optical signal"*

1074. Sparks discloses to a POSITA "the output port for an output multi-wavelength optical signal."

1075. Sparks discloses having at least one output fiber for the beam. "Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Sparks at 2:66-3:2.

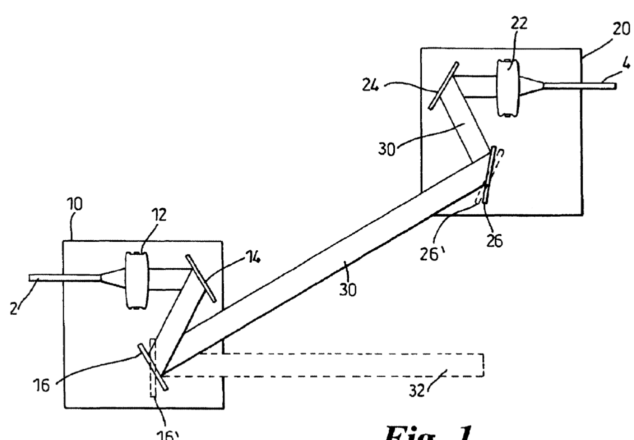


Fig. 1

Sparks at FIG. 1. Sparks discloses the light from each input fiber may be directed to any of the output fibers, thus creating an output multi-wavelength optical signal. "By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array." Sparks at 4:33-35.

1076. Therefore, Sparks discloses to a POSITA "the output port for an output multi-wavelength optical signal." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(vi) *'905 Patent, [23-d] "a wavelength-selective device for spatially separating said spectral channels"*

1077. Sparks discloses to a POSITA "a wavelength-selective device for spatially separating said spectral channels."

1078. Sparks discloses separating a signal by demultiplexing the signal prior to input into the switch. If the optical system is being used as part of a WDM system, it is typical for the signal to be demultiplexed into the separate optical channels prior to input to the switch." Sparks at 2:26-38. The separated signal can then be sent to different input fibers. "Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Sparks at 3:3-9.

1079. Therefore, Sparks discloses to a POSITA "a wavelength-selective device for spatially separating said spectral channels." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(vii) *'905 Patent, [23-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port"*

1080. Sparks discloses to a POSITA "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels."

1081. Sparks discloses to a POSITA "each of said elements being … continuously controllable … to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports."

1082. Sparks discloses to a POSITA "each of said elements being … continuously controllable … to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports."

1083. Sparks discloses to a POSITA "each of said elements being individually and continuously controllable … to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports."

1084. As shown in Figure 1, Sparks discloses multiple fixed and movable mirrors (reference number 14, 16, 24, and 26) to reflect light beams. The movable mirror (reference number 16) can be individually controlled to reflect the light along one path (reference number 30) or to reflect the light along another path (reference number 32). "This particular optical switch is constructed of a number of modules or units. FIG. 1 shows the optical path which represents a connection between the two modules 10, 20. Light from a fibre 2 passes through a focussing lens 12. The light which forms the beam is reflected off a fixed mirror 14 to keep device packaging small. It is then reflected off a movable mirror 16 which precisely directs the

beam in two axes. If the movable mirror is in position 16′, the beam will move along an alternative path shown as 32.” Sparks at 4:15-23.

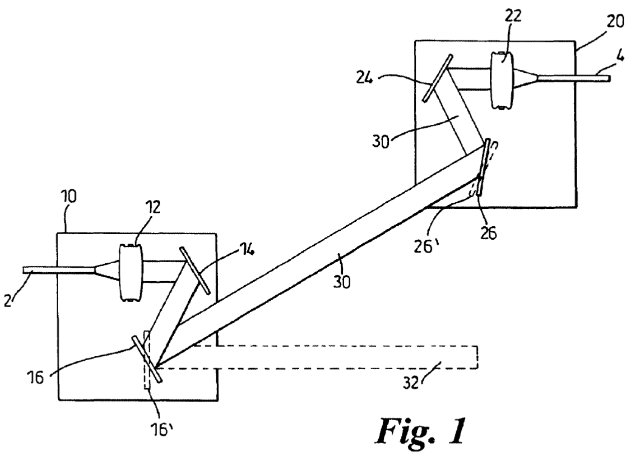


Fig. 1

Sparks at FIG. 1. Further, Sparks discloses the mirrors are able to reflect light in along two axes. “This particular optical switch is constructed of a number of modules or units. FIG. 1 shows the optical path which represents a connection between the two modules 10, 20. Light from a fibre 2 passes through a focussing lens 12. The light which forms the beam is reflected off a fixed mirror 14 to keep device packaging small. It is then reflected off a movable mirror 16 which precisely directs the beam in two axes. If the movable mirror is in position 16', the beam will move along an alternative path shown as 32.” Sparks at 4:15-23. Thus, the mirrors are able to reflect light along two dimensions.

1085. Sparks discloses controlling the power of the reflected beams. As shown in Figures 3a, 3b and 4, the mirrors are able to control the power of the beam reflected to an output fiber, by controlling how much of the beam is reflected by the mirror. “The present invention utilises a control system to control the mirrors so as to deliberately misalign the optical beam path 30 through the switch. By non-optimally aligning the optical beam path, the optical beam will be attenuated as it passes through the switch due to a reduction in the power of the beam coupled into the output fibre. This permits the switch to be utilised to achieve any desired

optical beam power output less than the maximum. Consequently, if desired, WDM system channels may be equalised. Such attenuation is achieved without incorporating separate attenuator(s) within the system." Sparks at 4:48-58; *see also id.* at 4:59-67 ("FIG. 4 shows an optical switch 100 as part of a telecommunications network 110, the switch having an optical path, a switching means 120 a control means 130 capable of receiving an input signal indicative of the power of an optical signal, and being arranged to control the functioning of said switching means for achieving misalignment of said optical beam path. A power measuring means 140 is arranged to provide a signal indicative of the power of the optical signal to the switching means.")

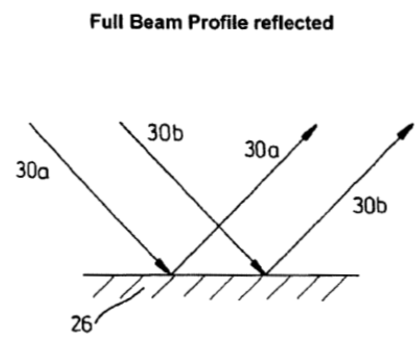


Fig. 3a

Sparks at FIG. 3A.

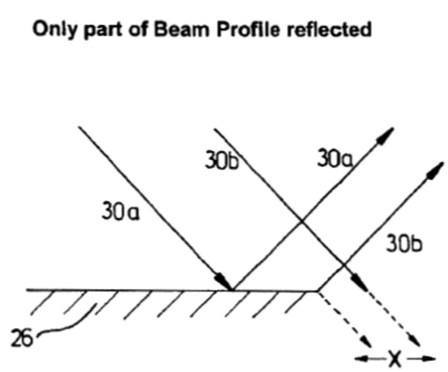


Fig. 3b

Sparks at FIG. 3B.

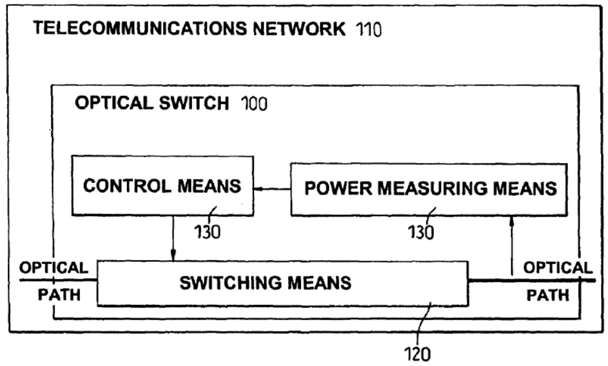


Fig. 4

Sparks at FIG. 4.

1086. Alternatively, Sparks can control the beam reflection by misaligning the path of the optical beam using optical fiber cladding. "FIG. 2a illustrates how the optical beam 30 would normally be coupled into the optical fiber core 4 a, which is surrounded by optical fibre cladding 4 b, by the focussing lens 22. If, in accordance with an embodiment of the present invention, the optical beam path is misaligned, e.g. either to misalignment of one of the mirrors 16, 26 or movement of the lens 22, then FIG. 2b illustrates how only a portion of the beam 30 will be coupled into the optical fibre core 4 a." Sparks at 5:1-8.

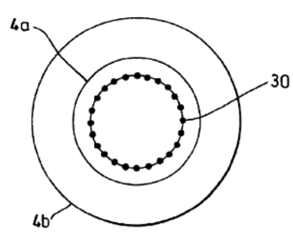


Fig. 2a

Sparks at FIG. 2A.

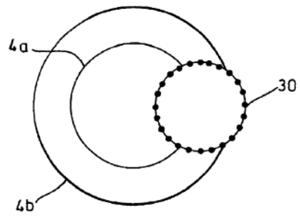


Fig 2b

Sparks at FIG. 2B.

1087. Therefore, Sparks discloses to a POSITA "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port" Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(viii) *'905 Patent, [24] "The optical add-drop apparatus of claim 23 further comprising a control unit for controlling each of said beam-deflecting elements"*

1088. Sparks discloses to a POSITA "a control unit for controlling each of said beam-deflecting elements."

1089. Sparks discloses a means for controlling the mirrors. "Preferably, the switch further comprises control means capable of receiving an input signal indicative of the power of an optical signal, the control means being arranged to control the functioning of said switching means for achieving misalignment of said optical beam path." Sparks at 3:28-32; *see also id.* at FIG. 4.

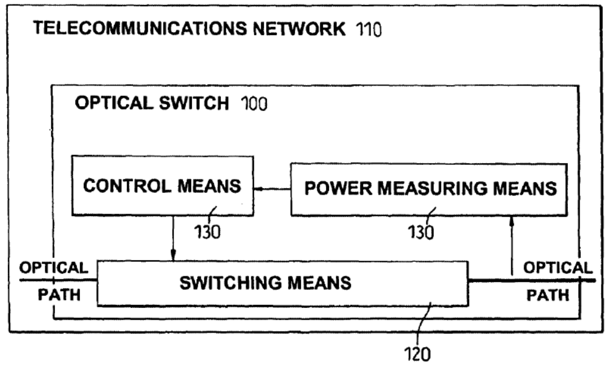


Fig. 4

1090. Sparks can control the mirrors by moving them, as shown in Figure 1. In one position, the beam is deflected along beam 30 ("the movable mirror 26 of the second module 20 is controlled to deflect the beam 30 towards the fixed mirror 24, into the lens 22 and hence into the fibre 4 completing the connection"). Sparks at 4:24-32. In another position, the beam is deflected along beam 32 ("If the movable mirror is in position 16', the beam will move along an alternative path shown as 32."). Sparks at 4:15-23.

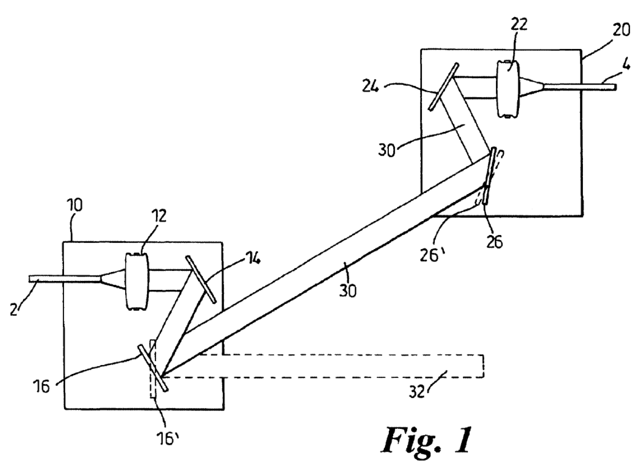


Fig. 1

Sparks at FIG. 1.

1091. Therefore, Sparks discloses to a POSITA "a control unit for controlling each of said beam-deflecting elements." Even if Sparks does not do so, however, these limitations

would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(ix)** *'905 Patent, [25] "The optical add-drop apparatus of claim 24, wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements"*

1092. Sparks discloses to a POSITA "a processing unit responsive to said power levels for controlling said beam-deflecting elements."

1093. As shown in Figure 4, Sparks discloses measuring the power of a signal, and using that measured power to control the power by controlling the movement of the mirrors and the deflection of the beam. "FIG. 4 shows an optical switch 100 as part of a telecommunications network 110, the switch having an optical path, a switching means 120 a control means 130 capable of receiving an input signal indicative of the power of an optical signal, and being arranged to control the functioning of said switching means for achieving misalignment of said optical beam path. A power measuring means 140 is arranged to provide a signal indicative of the power of the optical signal to the switching means." Sparks at 4:59-67; *see also id.* at 4:39-47 ("In normal operation a closed-loop servo control system is employed. This control system is normally used to provide high optical coupling efficiency between the fibres and to protect the optical signal against vibration and drift. The system operates by controlling the movable micromirrors (16,26), which are fabricated using MEMS technology and are capable of two axis movement, to carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch."), 4:48-58 ("The present invention utilises a control system to control the mirrors so as to deliberately misalign the optical beam path 30 through the switch. By non-optimally aligning the optical beam path, the optical beam will be

attenuated as it passes through the switch due to a reduction in the power of the beam coupled into the output fibre. This permits the switch to be utilised to achieve any desired optical beam power output less than the maximum. Consequently, if desired, WDM system channels may be equalised. Such attenuation is achieved without incorporating separate attenuator(s) within the system.").

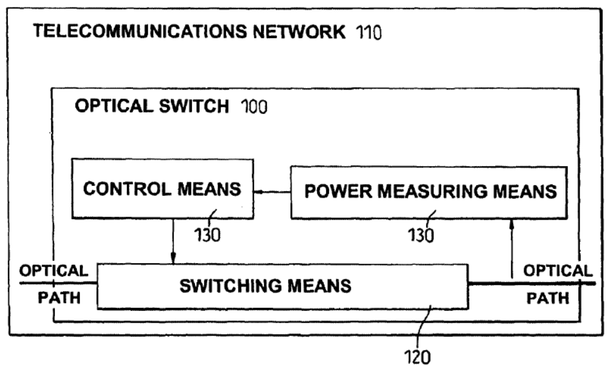


Fig. 4

Sparks at FIG. 4.

1094. Therefore, Sparks discloses to a POSITA "wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(x) *'905 Patent, [26] "The optical add-drop apparatus of claim 25, wherein said servo-control assembly maintains said power levels at predetermined values"*

1095. Sparks discloses to a POSITA "wherein said servo-control assembly maintains said power levels at predetermined values."

1096. Sparks discloses using a servo control system to achieve a predetermined output power by controlling the misalignment of the optical beam path. "In a further aspect, the present invention provides an optical switch comprising switching means arranged to switch an optical signal by redirection of the optical beam path of said signal, wherein said optical switch is arranged to misalign an optical beam path so as to provide a predetermined optical output power." Sparks at 3:22-27; *see also id.* at Abstract, 2:20-25, 3:3-9, 3:14-21, 3:37-43, 4:38-40 ("a closed-loop servo control system is employed. The control system is normally used to provide high optical coupling efficiency").

1097. Therefore, Sparks discloses to a POSITA "wherein said servo-control assembly maintains said power levels at predetermined values." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xi) *'905 Patent, [27] "The optical add-drop apparatus of claim 24, wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal"*

1098. To the extent Sparks does not teach "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xii) *'905 Patent, [28] "The optical add-drop apparatus of claim 24, wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal"*

1099. Sparks discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal."

1100. Sparks discloses controlling the beams to reflect them into any of the output fibers. For example, if light from a first input fiber is output at a first output fiber, light from a second input fiber can be added to the light output at the first input fiber. "By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array." Sparks at 4:33-38.

1101. Therefore, Sparks discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xiii) *'905 Patent, [29] "The optical add-drop apparatus of claim 23 further comprising alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device"*

1102. Sparks discloses to a POSITA "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device."

1103. Sparks discloses an array of fixed and movable mirrors or reflective surfaces that are aligned to control the misalignment of the optical beam. "Whilst the preferred embodiment

has been described as utilising a reflective surface (the mirrors) to misalign the optical beam path, it will of course be appreciated that by controlling the position and/or orientation of a refractive unit (e.g. a focussing lens within a switch), the beam path may be similarly misaligned by misaligning the lens in a controllable manner, a desired optical output power less than maximum (i.e. the optical output power if the optical path is perfectly aligned) can be achieved. Sparks at 5:26-34; *see also id.* at 4:59-67, 5:1-11, 5:12-25, FIG. 1.

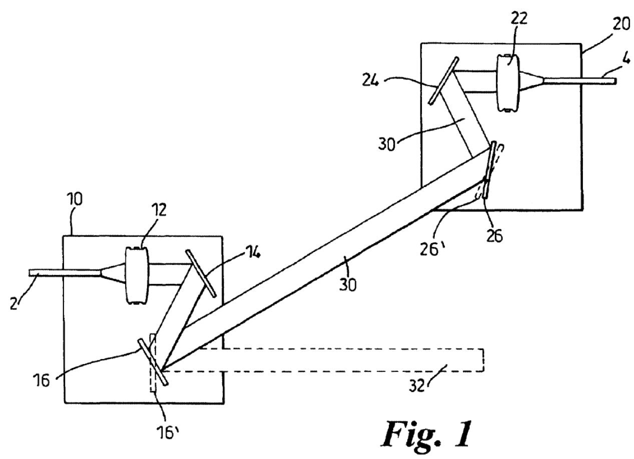


Fig. 1

1104. Therefore, Sparks discloses to a POSITA "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xiv) *'905 Patent, [31] "The optical add-drop apparatus of claim 23, wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal"*

1105. Sparks discloses to a POSITA "wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal."

1106. Sparks discloses controlling the beams to reflect them into any of the output fibers. For example, if light from a first input fiber is output at a first output fiber, light from a second input fiber can be added to the light output at the first input fiber. "By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array." Sparks at 4:33-38.

1107. Therefore, Sparks discloses to a POSITA "wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xv) *'905 Patent, [32] "The optical add-drop apparatus of claim 23, wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels"*

1108. To the extent Sparks does not teach "wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xvi) *'905 Patent, [33] "The optical add-drop apparatus of claim 23 further comprising a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements"*

1109. Sparks discloses to a POSITA "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements."

1110. Sparks discloses a focusing lens that receives the input light, and aligns the input light to be reflected by the array of mirrors. "This particular optical switch is constructed of a

number of modules or units. FIG. 1 shows the optical path which represents a connection between the two modules 10, 20. Light from a fibre 2 passes through a focussing lens 12. The light which forms the beam is reflected off a fixed mirror 14 to keep device packaging small. It is then reflected off a movable mirror 16 which precisely directs the beam in two axes. If the movable mirror is in position 16', the beam will move along an alternative path shown as 32." Sparks at 4:15-23; *see also id.* at FIG. 1.

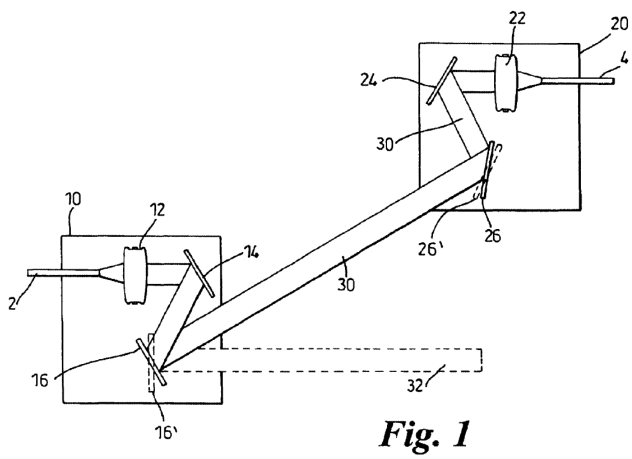


Fig. 1

1111. Therefore, Sparks discloses to a POSITA "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xvii) *'905 Patent, [34] "The optical add-drop apparatus of claim 23, wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms"*

1112. Sparks discloses to a POSITA "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."

1113. Sparks discloses diffracting an optical signal. For example, Sparks states "if the switch is of a diffraction type, such as might be achieved by an LC (liquid crystal) providing a controllable diffraction grating, or of a different reflective type (e.g. use of MEMS pop-up mirrors to act as a switch), by controlling the switching media to misalign the optical beam path(s), optical attenuation can be similarly achieved." Sparks at 5:35-45; *see also id.* at 3:12-13, 5:51-61.

1114. Therefore, Sparks discloses to a POSITA "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xviii) *'905 Patent, [35] "The optical add-drop apparatus of claim 23, wherein said beam-deflecting elements comprise micromachined mirrors"*

1115. Sparks discloses to a POSITA "wherein said beam-deflecting elements comprise micromachined mirrors."

1116. Sparks discloses the fixed and moveable mirrors being micromirrors fabricated using MEMS technology. "In normal operation a closed-loop servo control system is employed. This control system is normally used to provide high optical coupling efficiency between the fibres and to protect the optical signal against vibration and drift. The system operates by controlling the movable micromirrors (16,26), which are fabricated using MEMS technology and are capable of two axis movement, to carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch." Sparks at 4:39-47; *see also id.* at 5:35-45.

1117. Therefore, Sparks discloses to a POSITA "wherein said beam-deflecting elements comprise micromachined mirrors." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xix) *'905 Patent, [37] "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator"*

1118. Sparks discloses to a POSITA "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator." Sparks does include circulators in any of its claims, figures, or in the specification.

1119. Therefore, Sparks discloses to a POSITA "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xx) *'905 Patent, [39] "The optical add-drop apparatus of claim 23, wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array"*

1120. Sparks discloses "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a … array." To the extent Sparks does not teach "one-dimensional array[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1121. Sparks discloses an array of modules having inputs and outputs. "By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array. It should also be noted that the terms input and output are used for convenience, the optical path through any two modules in a connection being bi-directional." Sparks at 4:33-38.

1122. Therefore, Sparks discloses to a POSITA "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a … array." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Sparks does not teach "one dimensional array[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxi) *'905 Patent, [44] "The optical add-drop apparatus of claim 23, further comprising a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels"*

1123. Sparks discloses to a POSITA "a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels."

1124. As shown in Figure 4, Sparks discloses measuring the power of a signal, and using that measured power to control the power by controlling the movement of the mirrors and the deflection of the beam. "FIG. 4 shows an optical switch 100 as part of a telecommunications network 110, the switch having an optical path, a switching means 120 a control means 130 capable of receiving an input signal indicative of the power of an optical signal, and being arranged to control the functioning of said switching means for achieving misalignment of said

optical beam path. A power measuring means 140 is arranged to provide a signal indicative of the power of the optical signal to the switching means." Sparks at 4:59-67; *see also id.* 4:39-47 ("In normal operation a closed-loop servo control system is employed. This control system is normally used to provide high optical coupling efficiency between the fibres and to protect the optical signal against vibration and drift. The system operates by controlling the movable micromirrors (16,26), which are fabricated using MEMS technology and are capable of two axis movement, to carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch."), 4:48-58 ("The present invention utilises a control system to control the mirrors so as to deliberately misalign the optical beam path 30 through the switch. By non-optimally aligning the optical beam path, the optical beam will be attenuated as it passes through the switch due to a reduction in the power of the beam coupled into the output fibre. This permits the switch to be utilised to achieve any desired optical beam power output less than the maximum. Consequently, if desired, WDM system channels may be equalised. Such attenuation is achieved without incorporating separate attenuator(s) within the system.").

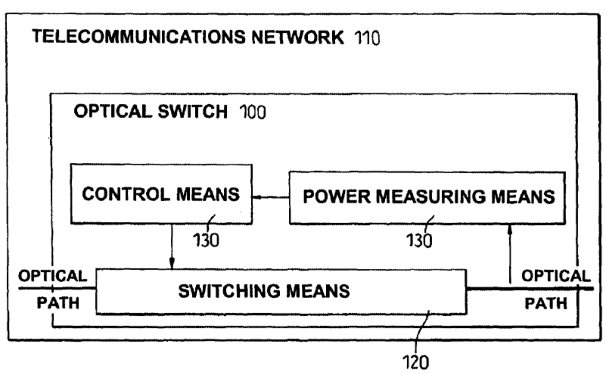


Fig. 4

Sparks at FIG. 4. Sparks can control the power levels for multiple input signals. "By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array." Sparks at 4:33-35.

1125. Therefore, Sparks discloses to a POSITA "a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxii) *'905 Patent, [45] "The optical add-drop apparatus of claim 44, wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port"*

1126. Sparks discloses to a POSITA "wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port."

1127. Sparks discloses controlling the coupling efficiency between the fibers to optimize the performance of the optical switch. "In normal operation a closed-loop servo control system is employed. This control system is normally used to provide high optical coupling efficiency between the fibres and to protect the optical signal against vibration and drift. The system operates by controlling the movable micromirrors (16,26), which are fabricated using MEMS technology and are capable of two axis movement, to carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch." Sparks at 4:39-47; *see also id.* at 2:51-65.

1128. Therefore, Sparks discloses to a POSITA "wherein the power-management system is further configured to control coupling efficiency of one of the first and second

spectral channel to at least one port." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxiii) *'905 Patent, [46] "The optical add-drop apparatus of claim 23, wherein the beam-deflecting elements are micromirrors"*

1129. Sparks discloses to a POSITA "wherein the beam-deflecting elements are micromirrors."

1130. Sparks discloses the fixed and moveable mirrors being micromirrors fabricated using MEMS technology. "In normal operation a closed-loop servo control system is employed. This control system is normally used to provide high optical coupling efficiency between the fibres and to protect the optical signal against vibration and drift. The system operates by controlling the movable micromirrors (16,26), which are fabricated using MEMS technology and are capable of two axis movement, to carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch." Sparks at 4:39-47; *see also id.* at 5:35-45.

1131. Therefore, Sparks discloses to a POSITA "wherein the beam-deflecting elements are micromirrors." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxiv) *'905 Patent, [47-pre] "An optical add-drop apparatus, comprising"*

1132. I previously analyzed Sparks in view of the following limitations:

- "[a]n optical add-drop apparatus," discussed above in Section IX.1.e.ii (Paragraphs 1063-1066).

I incorporate that analysis by reference.

(xxv) *'905 Patent, [47-a] "a fiber collimator serving as an input port for an input multi-wavelength optical signal having multiple spectral channels"*

1133. I previously analyzed Sparks in view of the following limitations:

- "fiber collimators serving as an input port . . . ," discussed above in Section IX.1.e.ii (Paragraphs 1063-1066); and

- "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels[,]" discussed above in Section IX.1.e.iii (Paragraphs 1067-1069).

I incorporate that analysis by reference.

(xxvi) *'905 Patent, [47-b] "an output port for an output multi-wavelength optical signal"*

1134. I previously analyzed Sparks in view of the following limitations:

- "an output port . . . ," discussed above in Section IX.1.e.ii (Paragraphs 1063-1066); and

- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.e.v (Paragraphs 1073-1075).

I incorporate that analysis by reference.

(xxvii) *'905 Patent, [47-c] "one or more fiber collimators serving as one or more drop ports for selected spectral channels dropped from said multi-wavelength optical signal"*

1135. I previously analyzed Sparks in view of the following limitations:

- "fiber collimators serving as . . . one or more other ports . . . ," discussed above in Section IX.1.e.ii (Paragraphs 1063-1066);

- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.e.xi (Paragraph 1097);

- "wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.e.xv (Paragraph 1107).

I incorporate that analysis by reference.

(xxviii) *'905 Patent, [47-d] "a wavelength-selective device for spatially separating said multiple spectral channels"*

1136. I previously analyzed Sparks in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.e.vi (Paragraphs 1076-1078).

I incorporate that analysis by reference.

(xxix) *'905 Patent, [47-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports and to control the power of the spectral channel reflected to said output port of the fiber collimator serving as said selected port, whereby a subset of said spectral channels is directed to said fiber collimator serving as said drop ports"*

1137. I previously analyzed Sparks in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086);

- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.e.xi (Paragraph 1097); and

- "wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.e.xv (Paragraph 1107).

I incorporate that analysis by reference.

(xxx) *'905 Patent, [48] "The optical add-drop apparatus of claim 47, wherein none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"*

1138. I previously analyzed Sparks in view of the following limitations:

- "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]" discussed above in Section IX.1.e.xix (Paragraphs 1117-1118).

I incorporate that analysis by reference.

(xxxi) *'905 Patent, [49] "An optical add-drop apparatus, comprising"*

1139. I previously analyzed Sparks in view of the following limitations:

- "[a]n optical add-drop apparatus[,]" discussed above in Section IX.1.e.ii (Paragraphs 1063-1066).

I incorporate that analysis by reference.

(xxxii) *'905 Patent, [49-a] "a fiber collimator serving as an input port for an input multi-wavelength optical signal having multiple spectral channels"*

1140. I previously analyzed Sparks in view of the following limitations:

- "fiber collimators serving as an input port . . . [,]" discussed above in Section IX.1.e.ii (Paragraphs 1063-1066); and
- "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels[,]" discussed above in Section IX.1.e.iii (Paragraphs 1067-1069).

I incorporate that analysis by reference.

(xxxiii) *'905 Patent, [49-b] "an output port for an output multi-wavelength optical signal"*

1141. I previously analyzed Sparks in view of the following limitations:

- "an output port . . . ," discussed above in Section IX.1.e.ii (Paragraphs 1063-1066); and

- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.e.v (Paragraphs 1073-1075).

I incorporate that analysis by reference.

(xxxiv) *'905 Patent, [49-c] "one or more fiber collimators serving as one or more add ports for selected spectral channels to be added to said output multi-wavelength optical signal"*

1142. I previously analyzed Sparks in view of the following limitations:

- "fiber collimators serving as . . . one or more other ports . . . ," discussed above in Section IX.1.e.ii (Paragraphs 1063-1066);
- "direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.e.xii (Paragraphs 1098-1100); and
- "wherein said fiber collimator one or more other ports comprise a fiber collimator add port . . for respectively adding second . . . spectral channels[,]" discussed above in Section IX.1.e.xv (Paragraph 1107).

I incorporate that analysis by reference.

(xxxv) *'905 Patent, [49-d] "a wavelength-selective device for reflecting said multiple and said selected spectral channels"*

1143. I previously analyzed Sparks in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.e.vi (Paragraphs 1076-1078).

I incorporate that analysis by reference.

1144. Sparks discloses to a POSITA "a wavelength-selective device for reflecting said multiple and said selected spectral channels."

1145. As shown in Figures 1, 3a, and 3b, Sparks discloses a focusing lens that can receive an input light signal, and refracting or separating the light onto a reflective mirror surface. "Whilst the preferred embodiment has been described as utilising a reflective surface (the mirrors) to misalign the optical beam path, it will of course be appreciated that by controlling the position and/or orientation of a refractive unit (e.g. a focussing lens within a

switch), the beam path may be similarly misaligned by misaligning the lens in a controllable manner, a desired optical output power less than maximum (i.e. the optical output power if the optical path is perfectly aligned) can be achieved." Sparks at 5:26-34. Once the light passes through the focusing lens, it is then reflected by the mirror array. "Light from a fibre 2 passes through a focussing lens 12. The light which forms the beam is reflected off a fixed mirror 14 to keep device packaging small." Sparks at 4:15-20.

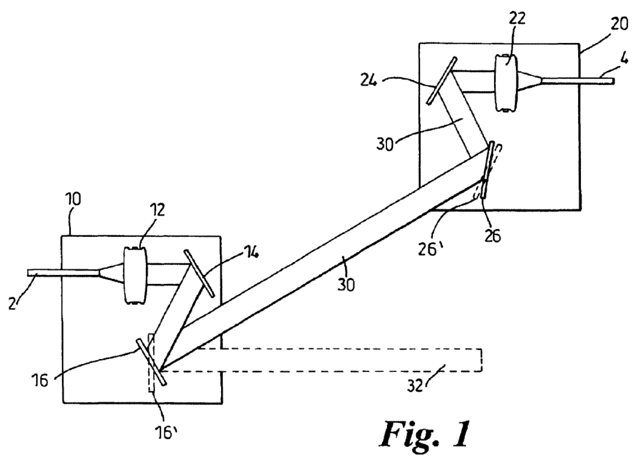


Fig. 1

Sparks at FIG. 1.

Full Beam Profile reflected

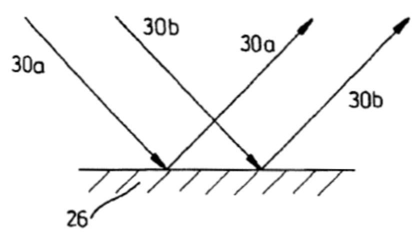


Fig. 3a

Sparks at FIG. 3A.

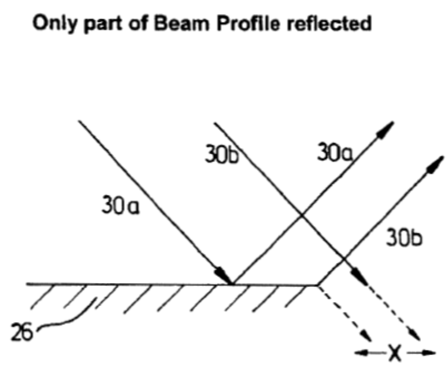


Fig. 3b

Sparks at FIG. 3B.

1146. Therefore, Sparks discloses to a POSITA "a wavelength-selective device for reflecting said multiple and said selected spectral channels." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxxvi) *'905 Patent, [49-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports and to control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port, whereby said spectral channels from said fiber collimators serving as said add ports are selectively provided to said output port"*

1147. I previously analyzed Sparks in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086);

- "direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.e.xii (Paragraphs 1098-1100); and

- "wherein said fiber collimator one or more other ports comprise a fiber collimator add port . . for respectively adding second . . . spectral channels[,]" discussed above in Section IX.1.e.xv (Paragraph 1107).

I incorporate that analysis by reference.

(xxxvii) *'905 Patent, [50] "The optical add-drop apparatus of claim 49, wherein none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"*

1148. I previously analyzed Sparks in view of the following limitations:

- "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]" discussed above in Section IX.1.e.xix (Paragraphs 1117-1118).

I incorporate that analysis by reference.

(xxxviii) *'905 Patent, [51-pre] "A method of performing dynamic add and drop in a WDM optical network, comprising"*

1149. I previously analyzed Sparks in view of the following limitations:

- "[a]n optical add-drop apparatus[,]" discussed above in Section IX.1.e.ii (Paragraphs 1063-1066);

- "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.e.xi (Paragraph 1097); and

- "the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.e.xii (Paragraphs 1098-1100).

I incorporate that analysis by reference.

1150. To the extent the language in the preamble is considered limiting, Sparks discloses "[a] method of performing dynamic add … in a WDM optical network." To the extent Sparks does not teach "drop[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1151. Sparks discloses constantly controlling the power of the optical channels. "In wavelength division multiplexed (WDM) transmission, it is desirable to control the power of the individual optical channels or wavelengths. Channels could be controlled to provide constant system signal to noise ratio. One of the simplest methods of control is to maintain each of the power levels of the individual wavelength components (channels) at substantially the same level." Sparks at 1:20-26. Further, Sparks discloses controlling the beams to reflect them into any of the output fibers. For example, if light from a first input fiber is output at a first output fiber, light from a second input fiber can be added to the light output at the first input fiber. "By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array." Sparks at 4:33-38.

1152. Therefore, Sparks discloses to a POSITA "[a] method of performing dynamic add … in a WDM optical network." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Sparks does not teach "drop[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxxix) *'905 Patent, [51-a] "separating an input multi-wavelength optical signal into spectral channels"*

1153. I previously analyzed Sparks in view of the following similar limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.e.vi (Paragraphs 1076-1078).

I incorporate that analysis by reference.

(xl) *'905 Patent, [51-b] "imaging each of said spectral channels onto a corresponding beam-deflecting element"*

1154. I previously analyzed Sparks in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channel[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086); and

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.e.xvi (Paragraphs 1108-1110).

I incorporate that analysis by reference.

(xli) *'905 Patent, [51-c] "controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal"*

1155. I previously analyzed Sparks in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086);

- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.e.viii (Paragraphs 1087-1090);

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.e.ix (Paragraphs 1091-1093); and

- "said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form

> said output multi-wavelength optical signal[,]" discussed above in Section IX.1.e.xiv (Paragraphs 1104-1106) and

I incorporate that analysis by reference.

1156. Sparks discloses to a POSITA "controlling dynamically … said beam-deflecting elements."

1157. Sparks discloses mirrors that are individually controllable to constantly control the power of the optical channels. "In wavelength division multiplexed (WDM) transmission, it is desirable to control the power of the individual optical channels or wavelengths. Channels could be controlled to provide constant system signal to noise ratio. One of the simplest methods of control is to maintain each of the power levels of the individual wavelength components (channels) at substantially the same level." Sparks at 1:20-26. Further, as shown in Figure 1, Sparks discloses multiple fixed and movable mirrors (reference number 14, 16, 24, and 26) to reflect light beams. The movable mirror (reference number 16) can be individually controlled to reflect the light along one path (reference number 30) or to reflect the light along another path (reference number 32). "This particular optical switch is constructed of a number of modules or units. FIG. 1 shows the optical path which represents a connection between the two modules 10, 20. Light from a fibre 2 passes through a focussing lens 12. The light which forms the beam is reflected off a fixed mirror 14 to keep device packaging small. It is then reflected off a movable mirror 16 which precisely directs the beam in two axes. If the movable mirror is in position 16′, the beam will move along an alternative path shown as 32." Sparks at 4:15-23.

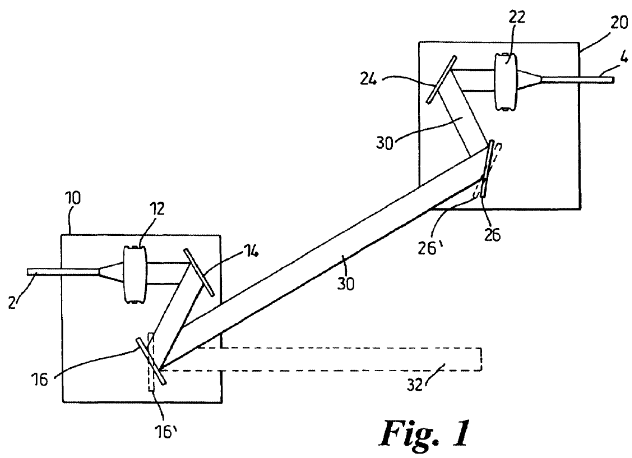


Fig. 1

Sparks at FIG. 1.

1158. Therefore, Sparks discloses to a POSITA "controlling dynamically . . . said beam deflecting elements." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xlii) *'905 Patent, [51-d] "receiving the output multi-wavelength optical signal at an output port that transmits the output multi-wavelength optical signal to an optical fiber; and wherein"*

1159. I previously analyzed Sparks in view of the following limitations:

- "an output port[,]" discussed above in Section IX.1.e.ii (Paragraphs 1063-1066);
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.e.v (Paragraphs 1073-1075); and
- "each of said elements . . . reflect[ing] its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086).

I incorporate that analysis by reference.

1160. Sparks discloses to a POSITA "an output port that transmits the output multi-wavelength optical signal to an optical fiber."

1161. Sparks discloses controlling the beams to reflect them into any of the output fibers. For example, if light from a first input fiber is output at a first output fiber, light from a second input fiber can be added to the light output at the first input fiber. "By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array." Sparks at 4:33-38.

1162. Therefore, Sparks discloses to a POSITA "an output port that transmits the output multi-wavelength optical signal to an optical fiber." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xliii) *'905 Patent, [51-e] "said selected ones of said spectral channels comprises a subset of said spectral channels, such that other non-selected ones of said spectral channels are dropped from said output multi-wavelength optical signal; and"*

1163. I previously analyzed Sparks in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086);
- "direct[ing] selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.e.xi (Paragraph 1097); and
- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.e.xv (Paragraph 1107).

I incorporate that analysis by reference.

(xliv) *'905 Patent, [51-f] "said controlling comprises reflecting said non-selected ones of said spectral channels to one or more fiber collimator serving as drop ports"*

1164. I previously analyzed Sparks in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086);

- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.e.viii (Paragraphs 1087-1090);

- "direct[ing] selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.e.xi (Paragraph 1097); and

- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.e.xv (Paragraph 1107).

I incorporate that analysis by reference.

(xlv) *'905 Patent, [52] "The method of claim 51 further comprising imaging other spectral channels onto other corresponding beam-deflecting elements, and controlling dynamically and continuously said other beam-deflecting elements so as to combine said other spectral channels with said selected ones of said spectral channels into said output multi-wavelength optical signal"*

1165. I previously analyzed Sparks in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086);

- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.e.viii (Paragraphs 1087-1090);

- "direct[ing] selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.e.xii (Paragraphs 1098-1100); and

- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.e.xv (Paragraph 1107).

- "controlling dynamically . . . beam-deflecting elements[,]" discussed above in Section IX.1.e.xli (Paragraphs 1154-1157).

I incorporate that analysis by reference.

(xlvi) *'905 Patent, [53] "The method of claim 51, wherein said imaging comprises focusing said spectral channels onto said beam-deflecting elements"*

1166. I previously analyzed Sparks in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086); and

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.e.xvi (Paragraphs 1108-1110).

I incorporate that analysis by reference.

(xlvii) *'905 Patent, [54] "The method of claim 51 further comprising monitoring a power level in one or more of said selected ones of said spectral channels, and controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring"*

1167. I previously analyzed Sparks in view of the following limitations:

- "a spectral monitor for monitoring said power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.e.ix (Paragraphs 1091-1093).

I incorporate that analysis by reference.

(xlviii) *'906 Patent, [68-pre] "A wavelength-separating-routing apparatus, comprising"*

1168. Sparks discloses to a POSITA "[a] wavelength-separating-routing apparatus."

1169. Sparks discloses diffracting an optical signal. For example, Sparks states "if the switch is of a diffraction type, such as might be achieved by an LC (liquid crystal) providing a controllable diffraction grating, or of a different reflective type (e.g. use of MEMS pop-up mirrors to act as a switch), by controlling the switching media to misalign the optical beam

path(s), optical attenuation can be similarly achieved." Sparks at 5:35-45; *see also id.* at 3:12-13, 5:51-61. The separated wavelengths can be arranged to be transmitted by multiple input fibers. "Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Sparks at 2:66-3:2.

1170. Therefore, Sparks discloses to a POSITA "[a] wavelength-separating-routing apparatus." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xlix) *'906 Patent, [68-a] "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports"*

1171. I previously analyzed Sparks in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.e.iii (Paragraphs 1067-1069).

I incorporate that analysis by reference.

1172. Under Capella's apparent construction, Sparks discloses to a POSITA "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports."

1173. As shown in Figure 1, Sparks discloses a focusing lens (reference number 22) that can receive the output beam before transmitting the beam to the output fiber (reference number 4). "To make an optical connection between modules 10,20, the movable mirror 16 directs the beam at the movable mirror 26 of a targeted second module 20. At the same time the movable

mirror 26 of the second module 20 is controlled to deflect the beam 30 towards the fixed mirror 24, into the lens 22 and hence into the fibre 4 completing the connection." Sparks at 4:24-32. Thus, Sparks discloses receiving multiple signals (for example, from multiple input signals, (*see* Sparks at 4:33-35 ("By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array.")), combine the multiple signals, and output them into a single output fiber.

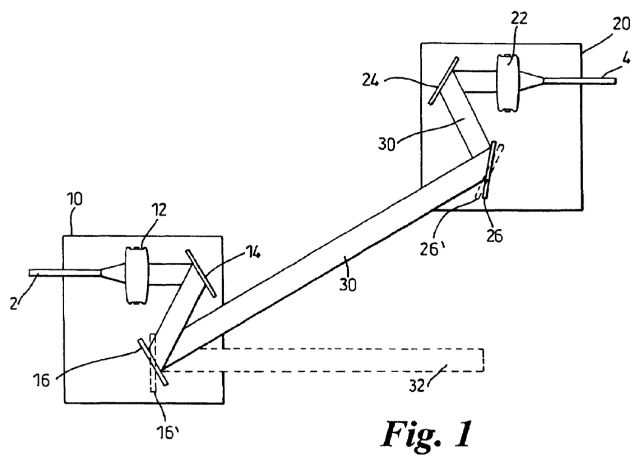


Fig. 1

Sparks at FIG. 1. Further, Sparks discloses there can be multiple sets of focusing lenses for the multiple sets of inputs and outputs. "Preferably, the optical switch comprises at least two inputs and two outputs, and said measurement step comprises determining the relative ratios between the optical powers of at least any two optical signals." Sparks at 2:66-3:2. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

1174. Therefore, under Capella's apparent construction, Sparks discloses to a POSITA "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports." Even if Sparks does not do so, however, these

limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(l) *'906 Patent, [68-b] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

1175. I previously analyzed Sparks in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.e.vi (Paragraphs 1076-1078).

I incorporate that analysis by reference.

(li) *'906 Patent, [68-c] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

1176. I previously analyzed Sparks in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.e.xvi (Paragraphs 1108-1110).

I incorporate that analysis by reference.

1177. Sparks discloses to a POSITA that the channels are focused onto corresponding spectral spots.

1178. As shown in Figure 1, Sparks discloses a focusing lens (reference number 22) that can receive the output beam before transmitting the beam to the output fiber (reference number 4). The mirrors in the mirror array can then transmit to different output fibers. "To make an optical connection between modules 10,20, the movable mirror 16 directs the beam at the movable mirror 26 of a targeted second module 20. At the same time the movable mirror 26 of the second module 20 is controlled to deflect the beam 30 towards the fixed mirror 24, into the lens 22 and hence into the fibre 4 completing the connection." Sparks at 4:24-32. Thus, Sparks discloses receiving multiple signals (for example, from multiple input signals, (*see* Sparks at 4:33-35 ("By having two arrays of such modules, optical signals coming in from a first array

may be directed into any of the output fibres of the second array.")), combine the multiple signals, and output them into a single output fiber.

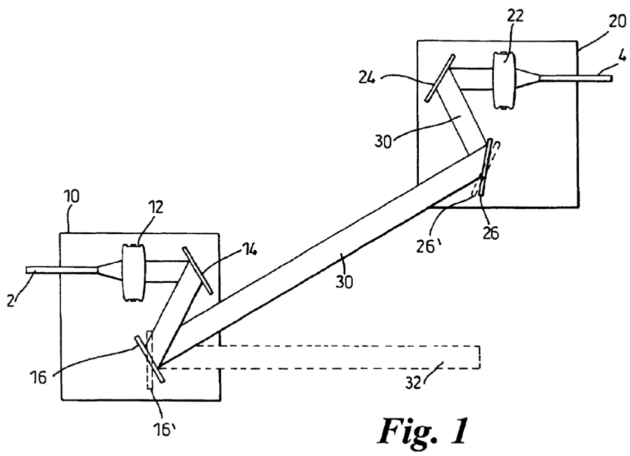


Fig. 1

Sparks at FIG. 1. Further, Sparks discloses there can be multiple sets of focusing lenses for the multiple sets of inputs and outputs. "Preferably, the optical switch comprises at least two inputs and two outputs, and said measurement step comprises determining the relative ratios between the optical powers of at least any two optical signals." Sparks at 2:66-3:2.

1179. Therefore, Sparks discloses to a POSITA that the channels are focused onto corresponding spectral spots. Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lii) *'906 Patent, [68-d] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports"*

1180. I previously analyzed Sparks in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of

> said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port [,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086).

I incorporate that analysis by reference.

1181. Sparks discloses to a POSITA the channel micromirrors are pivotal about two axes.

1182. Sparks discloses movable mirrors that can move to reflect a beam along two axes. "This particular optical switch is constructed of a number of modules or units. FIG. 1 shows the optical path which represents a connection between the two modules 10, 20. Light from a fibre 2 passes through a focussing lens 12. The light which forms the beam is reflected off a fixed mirror 14 to keep device packaging small. It is then reflected off a movable mirror 16 which precisely directs the beam in two axes. If the movable mirror is in position 16′, the beam will move along an alternative path shown as 32." Sparks at 4:15-23; *see also id.* at FIG. 1.

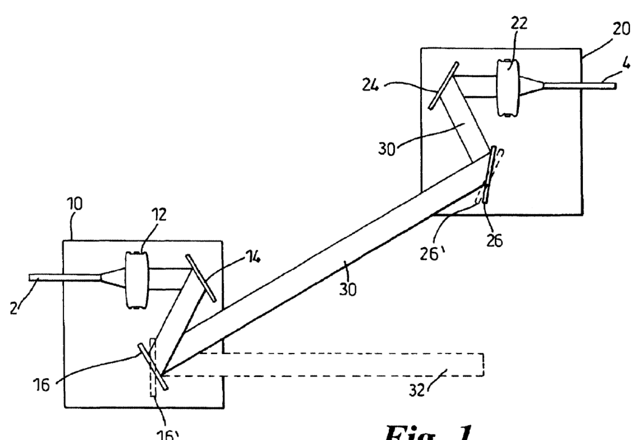


Fig. 1

1183. Therefore, Sparks discloses to a POSITA the channel micromirrors are pivotal about two axes. Even if Sparks does not do so, however, these limitations would have been

within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(liii)** *'906 Patent, [69] "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports"*

1184. I previously analyzed Sparks in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.e.ix (Paragraphs 1091-1093);
- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.e.x (Paragraphs 1094-1096); and
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.e.xxii (Paragraphs 1125-1127).

I incorporate that analysis by reference.

1185. Sparks discloses to a POSITA "a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports."

1186. Sparks discloses controlling the power of optical channels. "In wavelength division multiplexed (WDM) transmission, it is desirable to control the power of the individual optical channels or wavelengths. Channels could be controlled to provide constant system signal to noise ratio. One of the simplest methods of control is to maintain each of the power levels of the individual wavelength components (channels) at substantially the same level." Sparks at

1:20-26. Specifically, A closed loop feedback control system can continuously monitor the power of the optical signals. “If the optical switch is calibrated such that a predetermined misalignment produces a predetermined attenuation, then only a single indication of the optical signal power is necessary. If desired, such a power measurement could be performed substantially upstream or downstream of the optical switch, at a different point within the network if the attenuation characteristics of any intervening components are known. Alternatively, both the input and the output optical signal to the switch could be measured in order to directly indicate the degree of the attenuation of the optical signal as it passes through the switch. This information could be used to provide a closed loop feedback control system to ensure that the desired degree of attenuation is achieved for each optical signal (or channel).” Sparks at 2:51-65; *see also id.* at 4:39-47, 4:48-58.

1187. One way Sparks discloses maintaining the power at a predetermined level is to measure the power and use that measurement to control the mirrors. For example, “FIG. 4 shows an optical switch 100 as part of a telecommunications network 110, the switch having an optical path, a switching means 120 a control means 130 capable of receiving an input signal indicative of the power of an optical signal, and being arranged to control the functioning of said switching means for achieving misalignment of said optical beam path. A power measuring means 140 is arranged to provide a signal indicative of the power of the optical signal to the switching means.” Sparks at 4:59-67; *see also id.* at FIG. 4.

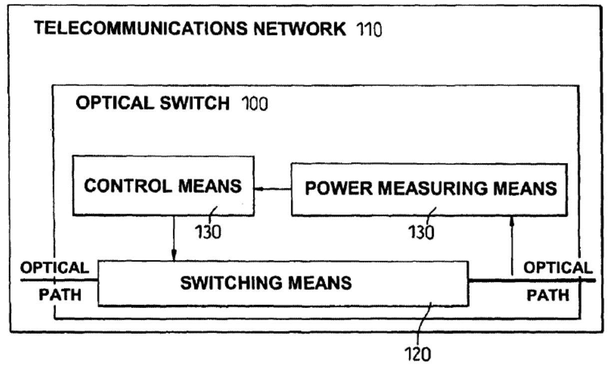


Fig. 4

1188. As a further example, Sparks discloses the mirrors being moveable to control maintain a predetermined optical output power. "Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Sparks at 2:66-3:2; *see also id.* at 4:24-32 (discussing moveable mirrors to control the beam deflection).

1189. Therefore, Sparks discloses to a POSITA "a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(liv)** *'906 Patent, [70] "The wavelength-separating-routing apparatus of claim 69 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

1190. I previously analyzed Sparks in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.e.ix (Paragraphs 1091-1093).

I incorporate that analysis by reference.

1191. Sparks discloses to a POSITA that the spectral monitor specifically monitors power levels is "of said spectral channels *coupled into said fiber collimator output ports*" and that the processing unit controls "channel micromirrors."

1192. Sparks discloses measuring both the input and output optical signal powers. "Preferably, said step of measuring the optical signal power comprises at least one of measuring the input optical signal power and measuring the output optical signal power." Sparks at 2:44-47; *see also id.* at 2:39-43, 2:51-65, 2:66-3:2, 3:34-36. It would be within the common knowledge of a POSITA to use a sensor to measure an optical signal. It would also be within the common knowledge of a POSITA to use the power measuring means (as shown in Figure 4 below) to monitor the power levels.

1193. Sparks further discloses measuring the power of a signal, and using that measured power to control the power by controlling the movement of the mirrors and the deflection of the beam. "FIG. 4 shows an optical switch 100 as part of a telecommunications network 110, the switch having an optical path, a switching means 120 a control means 130 capable of receiving an input signal indicative of the power of an optical signal, and being arranged to control the functioning of said switching means for achieving misalignment of said optical beam path. A

power measuring means 140 is arranged to provide a signal indicative of the power of the optical signal to the switching means." Sparks at 4:59-67; *see also id.* at 4:39-47 ("In normal operation a closed-loop servo control system is employed. This control system is normally used to provide high optical coupling efficiency between the fibres and to protect the optical signal against vibration and drift. The system operates by controlling the movable micromirrors (16,26), which are fabricated using MEMS technology and are capable of two axis movement, to carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch."); *see also id.* at 4:48-58 ("The present invention utilises a control system to control the mirrors so as to deliberately misalign the optical beam path 30 through the switch. By non-optimally aligning the optical beam path, the optical beam will be attenuated as it passes through the switch due to a reduction in the power of the beam coupled into the output fibre. This permits the switch to be utilised to achieve any desired optical beam power output less than the maximum. Consequently, if desired, WDM system channels may be equalised. Such attenuation is achieved without incorporating separate attenuator(s) within the system.").

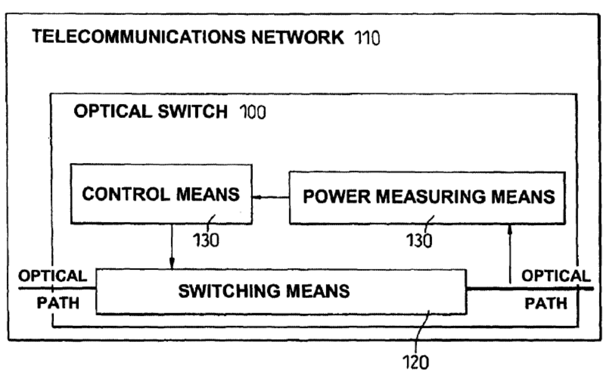


Fig. 4

Sparks at FIG. 4.

1194. Therefore, Sparks discloses to a POSITA that the spectral monitor specifically monitors power levels is "of said spectral channels *coupled into said fiber collimator output ports*" and that the processing unit controls "channel micromirrors." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lv) *'906 Patent, [71] "The wavelength-separating-routing apparatus of claim 70 wherein said servo-control assembly maintains said power levels at a predetermined value."*

1195. I previously analyzed Sparks in view of the following limitations:

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]" discussed above in Section IX.1.e.x (Paragraphs 1094-1096).

I incorporate that analysis by reference.

(lvi) *'906 Patent, [72] "The wavelength-separating-routing apparatus of claim 68 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."*

1196. I previously analyzed Sparks in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.e.xiii (Paragraphs 1101-1103); and
- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.e.xlvii (Paragraph 1166).

I incorporate that analysis by reference.

1197. Sparks discloses to a POSITA that the collimator-alignment mirrors are "in optical communication with said wavelength-separator and said fiber collimator input and

output ports" and "direct[] said reflected spectral channels into said fiber collimator output ports."

1198. Sparks discloses that an input signal (reference number 2) is focused by a focusing lens (reference number 12) onto a mirror (reference number 14) that is aligned to reflect the collimated signal onto a movable mirror (reference number 16), which reflects the signal onto another movable mirror (reference number 26), which reflects onto another mirror (reference number 24) that is aligned to reflect the signal to another lens (reference number 22) which focuses the signal to the output fiber (reference number 4).

1199. For example, "FIG. 1 shows the optical path which represents a connection between the two modules 10, 20. Light from a fibre 2 passes through a focussing lens 12. The light which forms the beam is reflected off a fixed mirror 14 to keep device packaging small. It is then reflected off a movable mirror 16 which precisely directs the beam in two axes. If the movable mirror is in position 16', the beam will move along an alternative path shown as 32." Sparks at 4:15-23; *see also id.* at 4:24-32 ("To make an optical connection between modules 10,20, the movable mirror 16 directs the beam at the movable mirror 26 of a targeted second module 20. At the same time the movable mirror 26 of the second module 20 is controlled to deflect the beam 30 towards the fixed mirror 24, into the lens 22 and hence into the fibre 4 completing the connection. It is the co-ordinated control of deflection angles by the two movable mirrors 16,26 that creates the optical connection between two transmission fibres 2,4.").

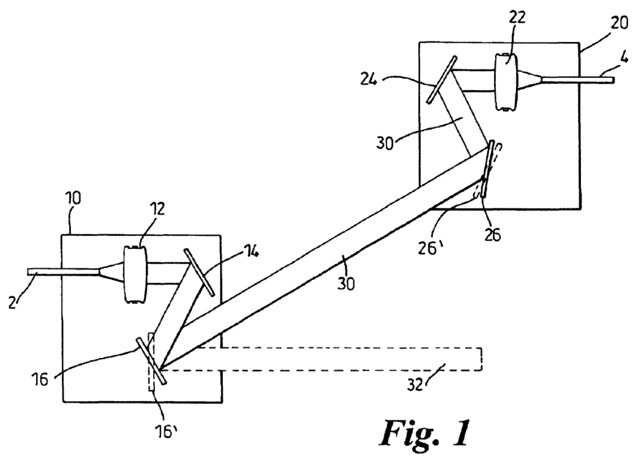


Fig. 1

1200. Therefore, Sparks discloses to a POSITA that the collimator-alignment mirrors are "in optical communication with said wavelength-separator and said fiber collimator input and output ports" and "direct[] said reflected spectral channels into said fiber collimator output ports." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lvii) *'906 Patent, [79] "The wavelength-separating-routing apparatus of claim 68 wherein each channel micromirror is a silicon micromachined mirror."*

1201. Sparks discloses "wherein each channel micromirror is a … micromachined mirror." To the extent Sparks does not teach "silicon," these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1202. Sparks discloses the fixed and moveable mirrors being micromirrors fabricated using MEMS technology. "In normal operation a closed-loop servo control system is employed. This control system is normally used to provide high optical coupling efficiency between the fibres and to protect the optical signal against vibration and drift. The system operates by controlling the movable micromirrors (16,26), which are fabricated using MEMS technology

and are capable of two axis movement, to carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch." Sparks at 4:39-47; *see also id.* at 5:35-45.

1203. Therefore, Sparks discloses to a POSITA "wherein each channel micromirror is a … micromachined mirror." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Sparks does not teach "silicon[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lviii) *'906 Patent, [80] "The wavelength-separating-routing apparatus of claim 68 wherein said fiber collimator input and output ports are arranged in a one-dimensional array."*

1204. I previously analyzed Sparks in view of the following limitations:

- "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array[,]"discussed above in Section IX.1.e.xx (Paragraphs 1119-1121).

I incorporate that analysis by reference.

(lix) *'906 Patent, [81] "The wavelength-separating-routing apparatus of claim 68 wherein said beam-focuser comprises a focusing lens having first and second focal points."*

1205. Sparks discloses "wherein said beam-focuser comprises a focusing lens." To the extent Sparks does not teach "a focusing lens having first and second focal points[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1206. Sparks discloses a focusing lens coupled to the input fiber, and another focusing lens coupled to the output fiber. "This particular optical switch is constructed of a number of modules or units. FIG. 1 shows the optical path which represents a connection between the two

modules 10, 20. Light from a fibre 2 passes through a focussing lens 12. The light which forms the beam is reflected off a fixed mirror 14 to keep device packaging small. It is then reflected off a movable mirror 16 which precisely directs the beam in two axes. If the movable mirror is in position 16', the beam will move along an alternative path shown as 32." Sparks at 4:15-23; *see also id.* at 4:24-32.

1207. Therefore, Sparks discloses to a POSITA "wherein said beam-focuser comprises a focusing lens." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Sparks does not teach "a focusing lens having first and second focal points[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lx) *'906 Patent, [82] "The wavelength-separating-routing apparatus of claim 81 wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens."*

1208. To the extent Sparks does not teach "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxi) *'906 Patent, [83] "The wavelength-separating-routing apparatus of claim 68 wherein said beam-focuser comprises an assembly of lenses."*

1209. To the extent Sparks does not teach "wherein said beam-focuser comprises an assembly of lenses[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxii) *'906 Patent, [84] "The wavelength-separating-routing apparatus of claim 68 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing gratings."*

1210. I previously analyzed Sparks in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.e.xvii (Paragraphs 1111-1113).

I incorporate that analysis by reference.

(lxiii) *'906 Patent, [85] "The wavelength-separating-routing apparatus of claim 68 further comprising a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors."*

1211. To the extent Sparks does not teach "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxiv) *'906 Patent, [86] "The wavelength-separating-routing apparatus of claim 68 wherein each fiber collimator output port carries a single one of said spectral channels."*

1212. Under Capella's apparent interpretation, Sparks discloses to a POSITA "wherein each fiber collimator output port carries a single one of said spectral channels."

Sparks discloses optical signals being transmitted by an input fiber and into any output fiber. As such, a POSITA would understand that each output fiber (which can be coupled to a focusing lens that can collimate the beam into the output fiber, *see* Sparks at 4:24-32) can receive a single one of the optical signals from the different input fibers. "By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output

fibres of the second array." Sparks at 4:33-35; *see also id.* at FIG. 1. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

1213.

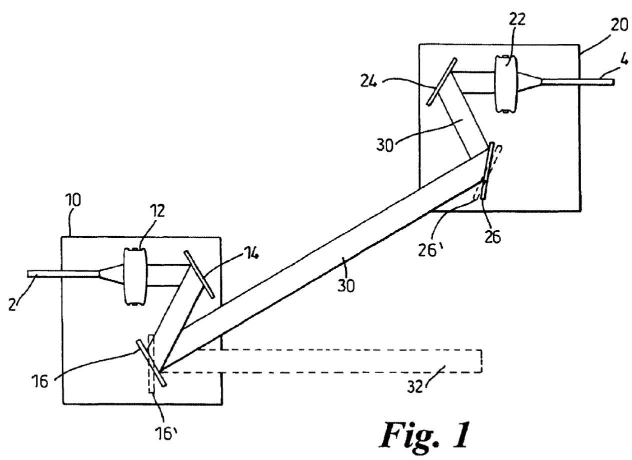


Fig. 1

1214. Therefore, Sparks discloses to a POSITA "wherein each fiber collimator output port carries a single one of said spectral channels." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxv) *'906 Patent, [87] "The wavelength-separating-routing apparatus of claim 86 further comprising one or more optical sensors, optically coupled to said fiber collimator output ports."*

1215. Sparks discloses to a POSITA "one or more optical sensors, optically coupled to said fiber collimator output ports."

1216. Sparks discloses measuring both the input and output optical signal powers. "Preferably, said step of measuring the optical signal power comprises at least one of measuring the input optical signal power and measuring the output optical signal power." Sparks at 2:44-47; *see also id.* at 2:39-43, 2:51-65, 2:66-3:2, 3:34-36. It would be within the common knowledge of a POSITA to use a sensor to measure an optical signal.

1217. Therefore, Sparks discloses to a POSITA "one or more optical sensors, optically coupled to said fiber collimator output ports." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxvi) *'906 Patent, [88] "The wavelength-separating-routing apparatus of claim 68, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator."*

1218. I previously analyzed Sparks in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.e.xix (Paragraphs 1117-1118).

I incorporate that analysis by reference.

(lxvii) *'906 Patent, [89-pre] "A servo-based optical apparatus comprising"*

1219. I previously analyzed Sparks in view of the following limitations:

- "An optical . . . apparatus[,]" discussed above in Section IX.1.e.ii (Paragraphs 1063-1066);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.e.viii (Paragraphs 1087-1090); and
- "wherein the control unit further comprises a servo-control assembly[,]" discussed above in Section IX.1.e.ix (Paragraphs 1091-1093).

I incorporate that analysis by reference.

(lxviii) *'906 Patent, [89-a] "multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports"*

1220. I previously analyzed Sparks in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.e.ii (Paragraphs 1063-1066); and

- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports [,]" discussed above in Section IX.1.e.xlix (Paragraphs 1170-1173).

I incorporate that analysis by reference.

(lxix) *'"906 Patent, [89-b] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

1221. I previously analyzed Sparks in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.e.vi (Paragraphs 1076-1078).

I incorporate that analysis by reference.

(lxx) *'906 Patent, [89-c] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

1222. I previously analyzed Sparks in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.e.xvi (Paragraphs 1108-1110).
- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.e.li (Paragraphs 1175-1178).

I incorporate that analysis by reference.

(lxxi) *'906 Patent, [89-d] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said fiber collimator output ports"*

1223. I previously analyzed Sparks in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator

selected port[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.e.lii (Paragraphs 1179-1182).

I incorporate that analysis by reference.

(lxxii) *'906 Patent, [89-e] "a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports."*

1224. I previously analyzed Sparks in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.e.ix (Paragraphs 1091-1093);

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.e.x (Paragraphs 1094-1096);

- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.e.xxii (Paragraphs 1125-1127); and

- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.e.liii (Paragraphs 1183-1188).

I incorporate that analysis by reference.

(lxxiii) *'906 Patent, [90] "The servo-based optical apparatus of claim 89 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

1225. I previously analyzed Sparks in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.e.ix (Paragraphs 1091-1093); and

- "said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors[,]" discussed above in Section IX.1.e.liv (Paragraphs 1189-1193).

I incorporate that analysis by reference.

(lxxiv) *'906 Patent, [91] "The servo-based optical apparatus of claim 90 wherein said servo-control assembly maintains said power levels at a predetermined value"*

1226. I previously analyzed Sparks in view of the following limitations:

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]" discussed above in Section IX.1.e.x (Paragraphs 1094-1096); and

- "wherein said servo-control assembly maintains said power levels at a predetermined value[,]" discussed above in Section IX.1.e.lv (Paragraph 1194).

I incorporate that analysis by reference.

(lxxv) *'906 Patent, [92] "The servo-based optical apparatus of claim 89 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."*

1227. I previously analyzed Sparks in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.e.xiii (Paragraphs 1101-1103);
- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.e.xlvii (Paragraph 1166); and
- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.e.lvi (Paragraphs 1195-1199)

I incorporate that analysis by reference.

(lxxvi) *'906 Patent, [96] "The servo-based optical apparatus of claim 89 wherein each channel micromirror is a silicon micromachined mirror."*

1228. I previously analyzed Sparks in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.e.lvii (Paragraphs 1200-1202).

I incorporate that analysis by reference.

(lxxvii) *'906 Patent, [97] "The servo-based optical apparatus of claim 89 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

1229. I previously analyzed Sparks in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.e.xvii (Paragraphs 1111-1113).

I incorporate that analysis by reference.

(lxxviii) *'906 Patent, [98] "The servo-based optical apparatus of claim 89 wherein said beam-focuser comprises one or more lenses."*

1230. I previously analyzed Sparks in view of the following limitations:

- "wherein said beam-focuser comprises an assembly of lenses [,]"discussed above in Section IX.1.e.lxi (Paragraph 1208).

I incorporate that analysis by reference.

(lxxix) *'906 Patent, [99] "The servo-based optical apparatus of claim 89, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"*

1231. I previously analyzed Sparks in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.e.xix (Paragraphs 1117-1118).

I incorporate that analysis by reference.

(lxxx) *'906 Patent, [100-pre] "An optical apparatus comprising:"*

1232. I previously analyzed Sparks in view of the following limitations:

- "An optical . . . apparatus[,]" discussed above in Section IX.1.e.ii (Paragraphs 1063-1066).

I incorporate that analysis by reference.

(lxxxi) *'906 Patent, [100-a] "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal"*

1233. I previously analyzed Sparks in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.e.ii (Paragraphs 1063-1066); and
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports [,]" discussed above in Section IX.1.e.xlix (Paragraphs 1170-1173).

I incorporate that analysis by reference.

1234. Under Capella's apparent interpretation, Sparks discloses to a POSITA an "array" of fiber collimators.

1235. As shown in Figure 1, Sparks discloses a focusing lens (reference number 22) that can receive the output beam before transmitting the beam to the output fiber (reference number 4). "To make an optical connection between modules 10,20, the movable mirror 16 directs the beam at the movable mirror 26 of a targeted second module 20. At the same time the movable mirror 26 of the second module 20 is controlled to deflect the beam 30 towards the fixed mirror 24, into the lens 22 and hence into the fibre 4 completing the connection." Sparks at 4:24-32. Thus, Sparks discloses receiving multiple signals (for example, from multiple input signals, (*see* Sparks at 4:33-35 ("By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array.")), combine the multiple signals, and output them into a single output fiber.

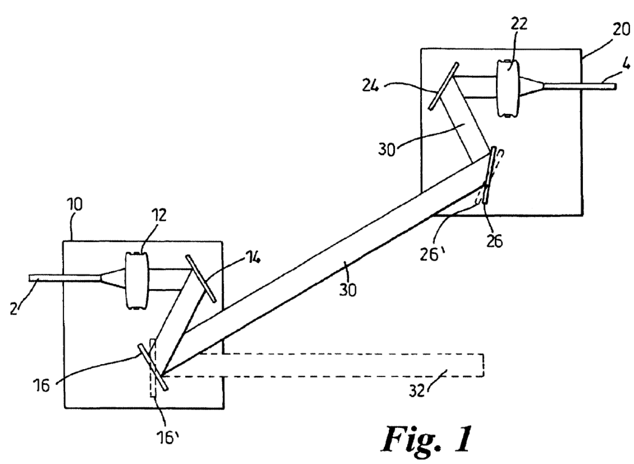


Fig. 1

Sparks at FIG. 1. Further, Sparks discloses there can be multiple modules having focusing lenses for the multiple sets of inputs and outputs. "Preferably, the optical switch comprises at least two inputs and two outputs, and said measurement step comprises determining the relative ratios between the optical powers of at least any two optical signals." Sparks at 2:66-3:2. Sparks discloses these multiple modules as an array of modules. For example, "By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array." Sparks at 4:33-35.

1236. Therefore, under Capella's apparent interpretation, Sparks discloses to a POSITA an "array" of fiber collimators. Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxxii) *'906 Patent, [100-b] "a plurality of output ports"*

1237. I previously analyzed Sparks in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.e.iii (Paragraphs 1067-1069).

I incorporate that analysis by reference.

(lxxxiii) *'906 Patent, [100-c] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

1238. I previously analyzed Sparks in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.e.vi (Paragraphs 1076-1078).

I incorporate that analysis by reference.

(lxxxiv) *'906 Patent, [100-d] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

1239. I previously analyzed Sparks in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.e.xvi (Paragraphs 1108-1110).

- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.e.li (Paragraphs 1175-1178).

I incorporate that analysis by reference.

(lxxxv) *'906 Patent, [100-e] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually and continuously controllable to reflect said spectral channels into selected ones of said output ports"*

1240. I previously analyzed Sparks in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.e.lii (Paragraphs 1179-1182).

I incorporate that analysis by reference.

(lxxxvi) *'906 Patent, [100-f] "a one-dimensional array of collimator-alignment mirrors, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports"*

1241. I previously analyzed Sparks in view of the following limitations:

- “alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]”discussed above in Section IX.1.e.xiii (Paragraphs 1101-1103);

- “controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]” discussed above in Section IX.1.e.xlvii (Paragraph 1166); and

- “an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.e.lvi (Paragraphs 1195-1199)

I incorporate that analysis by reference.

1242. Sparks discloses to a POSITA “one dimensional array.”

1243. Sparks discloses an array of modules having inputs and outputs. “By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array.” Sparks at 4:33-35.

1244. Therefore, Sparks discloses to a POSITA “one dimensional array.” Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxxvii) *’906 Patent, [106] “The optical apparatus of claim 100, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator”*

1245. I previously analyzed Sparks in view of the following limitations:

- “wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]”discussed above in Section IX.1.e.xix (Paragraphs 1117-1118).

I incorporate that analysis by reference.

(lxxxviii) *'906 Patent, [115-pre] "An optical system comprising a wavelength-separating-routing apparatus, wherein said wavelength-separating-routing apparatus includes"*

1246. I previously analyzed Sparks in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]" discussed above in Section IX.1.e.xlviii (Paragraphs 1167-1169).

I incorporate that analysis by reference.

1247. To the extent the language in the preamble is considered limiting, Sparks discloses to a POSITA "[a]n system comprising a wavelength-separating-routing apparatus."

1248. Sparks discloses an optical switch that can diffract an optical signal. For example, Sparks states "if the switch is of a diffraction type, such as might be achieved by an LC (liquid crystal) providing a controllable diffraction grating, or of a different reflective type (e.g. use of MEMS pop-up mirrors to act as a switch), by controlling the switching media to misalign the optical beam path(s), optical attenuation can be similarly achieved." Sparks at 5:35-45; *see also id.* at 3:12-13, 5:51-61. The separated wavelengths can be arranged to be transmitted by multiple input fibers. "Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Sparks at 2:66-3:2.

1249. Therefore, Sparks discloses to a POSITA "[a]n system comprising a wavelength-separating-routing apparatus." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxxix) *'906 Patent, [115-a] "an array of fiber collimators, providing and serving as an input port for a multi-wavelength optical signal"*

1250. I previously analyzed Sparks in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.e.ii (Paragraphs 1063-1066);
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.e.xlix (Paragraphs 1170-1173); and
- "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal[,]" discussed above in Section IX.1.e.lxxxi (Paragraphs 1232-1235).

I incorporate that analysis by reference.

(xc) *'906 Patent, [115-b] "a plurality of output ports including a pass-through port and one or more drop ports"*

1251. I previously analyzed Sparks in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.e.iii (Paragraphs 1067-1069); and
- "wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.e.xv (Paragraph 1107).

I incorporate that analysis by reference.

1252. To the extent Sparks does not teach "pass-through port[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xci) *'906 Patent, [115-c] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

1253. I previously analyzed Sparks in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.e.vi (Paragraphs 1076-1078).

I incorporate that analysis by reference.

(xcii) *'906 Patent, [115-d] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

1254. I previously analyzed Sparks in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.e.xvi (Paragraphs 1108-1110).
- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.e.li (Paragraphs 1175-1178).

I incorporate that analysis by reference.

(xciii) *'906 Patent, [115-e] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels."*

1255. I previously analyzed Sparks in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber

collimator output ports[,]" discussed above in Section IX.1.e.lii (Paragraphs 1179-1182)

I incorporate that analysis by reference.

1256. To the extent Sparks does not teach "said fiber collimator pass-through port receives a subset of said spectral channels[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xciv) *'906 Patent, [116] "The optical system of claim 115 further comprising a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports"*

1257. I previously analyzed Sparks in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.e.ix (Paragraphs 1091-1093);
- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.e.x (Paragraphs 1094-1096);
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.e.xxii (Paragraphs 1125-1127); and
- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.e.liii (Paragraphs 1183-1188).

I incorporate that analysis by reference.

(xcv) *'906 Patent, [117] "The optical system of claim 116 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

1258. I previously analyzed Sparks in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.e.ix (Paragraphs 1091-1093); and

- "said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors[,]" discussed above in Section IX.1.e.liv (Paragraphs 1189-1193).

I incorporate that analysis by reference.

(xcvi) *'906 Patent, [118] "The optical system of claim 115 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimators, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports."*

1259. I previously analyzed Sparks in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.e.xiii (Paragraphs 1101-1103);

- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.e.xlvii (Paragraph 1166); and

- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.e.lvi (Paragraphs 1195-1199)

I incorporate that analysis by reference.

(xcvii) *'906 Patent, [122] "The optical system of claim 115 wherein each channel micromirror is a silicon micromachined mirror."*

1260. I previously analyzed Sparks in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.e.lvii (Paragraphs 1200-1202).

I incorporate that analysis by reference.

(xcviii) *'906 Patent, [123] "The optical system of claim 115 wherein said beam-focuser comprises a focusing lens having first and second focal points, and wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points"*

1261. I previously analyzed Sparks in view of the following limitations:

- "wherein said beam-focuser comprises a focusing lens having first and second focal points[,]"discussed above in Section IX.1.e.lix (Paragraphs 1204-1206); and
- "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens[,]"discussed above in Section IX.1.e.lx (Paragraph 1207).

I incorporate that analysis by reference.

(xcix) *'906 Patent, [124] "The optical system of claim 115 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

1262. I previously analyzed Sparks in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.e.xvii (Paragraphs 1111-1113).

I incorporate that analysis by reference.

(c) *'906 Patent, [125] "The optical system of claim 115 further comprising a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors"*

1263. I previously analyzed Sparks in view of the following limitations:

- "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors[,]"discussed above in Section IX.1.e.lxiii (Paragraph 1210).

I incorporate that analysis by reference.

(ci) *'906 Patent, [126-pre] "The optical system of claim 115 further comprising an auxiliary wavelength-separating-routing apparatus, including:"*

1264. Sparks discloses to a POSITA "an auxiliary wavelength-separating-routing apparatus."

1265. Sparks discloses an optical switch that can diffract an optical signal. For example, Sparks states "if the switch is of a diffraction type, such as might be achieved by an LC (liquid crystal) providing a controllable diffraction grating, or of a different reflective type (e.g. use of MEMS pop-up mirrors to act as a switch), by controlling the switching media to misalign the optical beam path(s), optical attenuation can be similarly achieved." Sparks at 5:35-45; *see also id.* at 3:12-13, 5:51-61. The separated wavelengths can be arranged to be transmitted by multiple input fibers. "Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Sparks at 2:66-3:2.

1266. Sparks also discloses having multiple inputs and multiple outputs, which can each have focusing lenses coupled to the input fibers and the output fibers, and which can each have

an input fiber that inputs a diffracted signal. "Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Sparks at 2:66-3:2; *see also id.* at 3:3-9. As such, each signal can be demultiplexed prior to or at each input fiber.

1267. Therefore, Sparks discloses to a POSITA "an auxiliary wavelength-separating-routing apparatus." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cii) *'906 Patent, [126-a] "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports"*

1268. Under Capella's apparent interpretation, Sparks discloses to a POSITA "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports."

1269. Sparks also discloses the input fiber collimating the beam. As shown in Figure 3a, lines 30a and 30b, which run parallel to one another, indicate the beam direction. Sparks at 5:12-25. Having the ends of the beam defined by parallel lines 30a and 30b, it stands to reason that the input beam is collimated.

Full Beam Profile reflected

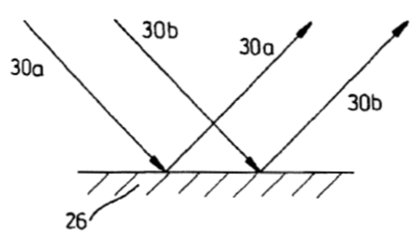


Fig. 3a

Sparks at FIG. 3A.

1270. Sparks also discloses having multiple inputs and multiple outputs, which can each have focusing lenses coupled to the input fibers and the output fibers (as disclosed in Figure 1 above). "Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Sparks at 2:66-3:2; *see also id.* at 3:3-9. As such, each signal can be demultiplexed prior to input. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

1271. Therefore, under Capella's apparent interpretation, Sparks discloses to a POSITA "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(ciii) *'906 Patent, [126-b] "an exiting port"*

1272. Sparks discloses to a POSITA "an exiting port."

1273. Sparks discloses having at least one output port for an optical signal to exit the optical switch. "Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Sparks at 2:66-3:2; *see also id.* at 3:3-9, FIG. 1.

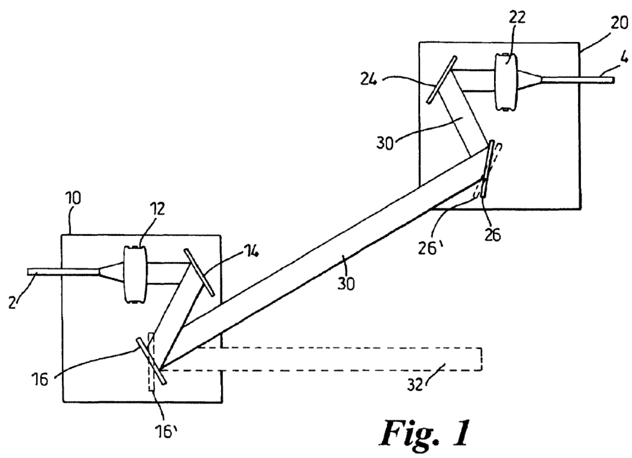


Fig. 1

1274. Therefore, Sparks discloses to a POSITA "an exiting port." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(civ) *"'906 Patent, [126-c] "an auxiliary wavelength-separator"*

1275. Sparks discloses to a POSITA "an auxiliary wavelength-separator."

1276. Sparks discloses separating a signal by demultiplexing the signal prior to input into the switch. If the optical system is being used as part of a WDM system, it is typical for the signal to be demultiplexed into the separate optical channels prior to input to the switch." Sparks at 2:26-38. The separated signal can then be sent to different input fibers. "Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Sparks at 3:3-9. Sparks also discloses having multiple inputs and multiple outputs, which can each have focusing lenses coupled to the input fibers and the output fibers (as disclosed in Figure 1 above). "Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning

respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Sparks at 2:66-3:2; *see also id.* at 3:3-9. As such, each signal can be demultiplexed prior to input.

1277. Therefore, Sparks discloses to a POSITA "an auxiliary wavelength-separator." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cv) *'906 Patent, [126-d] "an auxiliary beam-focuser"*

1278. Sparks discloses to a POSITA "an auxiliary beam-focuser."

1279. Sparks discloses a focusing lens coupled to an input fiber, and another focusing lens coupled to an output fiber. For example, "FIG. 1 shows the optical path which represents a connection between the two modules 10, 20. Light from a fibre 2 passes through a focussing lens 12. The light which forms the beam is reflected off a fixed mirror 14 to keep device packaging small." Sparks at 4:15-20; *see also id.* at 4:24-32 ("To make an optical connection between modules 10,20, the movable mirror 16 directs the beam at the movable mirror 26 of a targeted second module 20. At the same time the movable mirror 26 of the second module 20 is controlled to deflect the beam 30 towards the fixed mirror 24, into the lens 22 and hence into the fibre 4 completing the connection."); *see also id.* at FIG. 1.

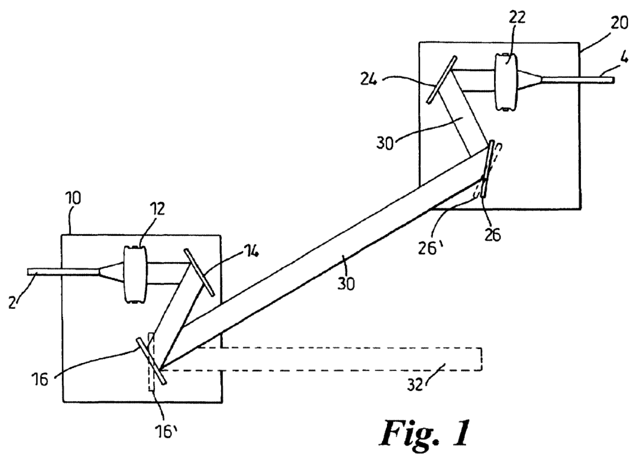


Fig. 1

1280. Further, Sparks discloses having multiple inputs and multiple outputs, which can each have focusing lenses coupled to the input fibers and the output fibers (as disclosed in Figure 1 above). "Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Sparks at 2:66-3:2; *see also id.* at 3:3-9.

1281. Therefore, Sparks discloses to a POSITA "an auxiliary beam-focuser." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cvi) *'906 Patent, [126-e] "a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors"*

1282. I previously analyzed Sparks in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086);

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.e.lii (Paragraphs 1179-1182); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels[,]" discussed in Section IX.1.e.xciii (Paragraphs 1254-1255).

I incorporate that analysis by reference.

(cvii) *'906 Patent, [127] "The optical system of claim 126 wherein said auxiliary channel micromirrors are individually pivotable."*

1283. Sparks discloses to a POSITA "wherein said auxiliary channel micromirrors are individually pivotable."

1284. Sparks discloses moving movable mirrors to carefully align an input optical signal with to be received by a movable mirror (reference number 16) and carefully aligning another moveable mirror 26 to align the optical signal with an output fiber. "This particular optical switch is constructed of a number of modules or units. FIG. 1 shows the optical path which represents a connection between the two modules 10, 20. Light from a fibre 2 passes through a

focussing lens 12. The light which forms the beam is reflected off a fixed mirror 14 to keep device packaging small. It is then reflected off a movable mirror 16 which precisely directs the beam in two axes. If the movable mirror is in position 16', the beam will move along an alternative path shown as 32." Sparks at 4:15-23; *see also id.* at 4:39-47 ("In normal operation a closed-loop servo control system is employed. This control system is normally used to provide high optical coupling efficiency between the fibres and to protect the optical signal against vibration and drift. The system operates by controlling the movable micromirrors (16,26), which are fabricated using MEMS technology and are capable of two axis movement, to carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch."), FIG. 1.

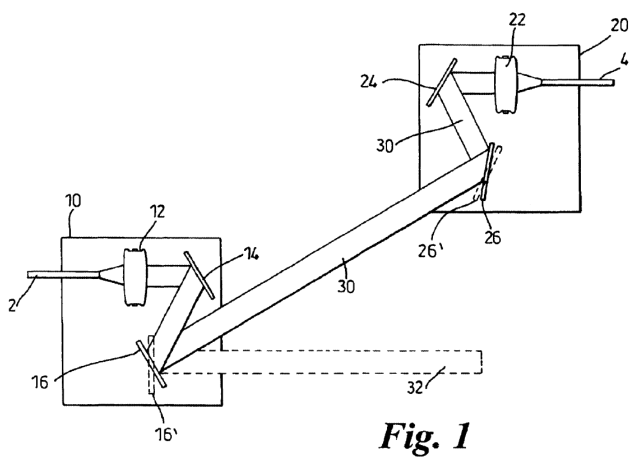


Fig. 1

1285. Therefore, Sparks discloses to a POSITA "wherein said auxiliary channel micromirrors are individually pivotable." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cviii) *'906 Patent, [129] "The optical system of claim 126 wherein each auxiliary channel micromirror is a silicon micromachined mirror"*

1286. Sparks discloses to a POSITA "wherein each auxiliary channel micromirror is a silicon micromachined mirror." Sparks discloses the fixed and moveable mirrors being micromirrors fabricated using MEMS technology. "In normal operation a closed-loop servo control system is employed. This control system is normally used to provide high optical coupling efficiency between the fibres and to protect the optical signal against vibration and drift. The system operates by controlling the movable micromirrors (16,26), which are fabricated using MEMS technology and are capable of two axis movement, to carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch." Sparks at 4:39-47; *see also id.* at 5:35-45 (where silicon is cited in the related art).

1287. Therefore, Sparks discloses to a POSITA "wherein each auxiliary channel micromirror is a silicon micromachined mirror." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cix) *'906 Patent, [130] "The optical system of claim 126 wherein said auxiliary wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

1288. Sparks discloses to a POSITA "wherein said auxiliary wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."

1289. Sparks discloses diffracting an optical signal. For example, Sparks states "if the switch is of a diffraction type, such as might be achieved by an LC (liquid crystal) providing a controllable diffraction grating, or of a different reflective type (e.g. use of MEMS pop-up mirrors to act as a switch), by controlling the switching media to misalign the optical beam path(s), optical attenuation can be similarly achieved." Sparks at 5:35-45; *see also id.* at 3:12-13, 5:51-61.

1290. Therefore, Sparks discloses to a POSITA "wherein said auxiliary wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cx) *'906 Patent, [131] "The optical system of claim 126 wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports."*

1291. To the extent Sparks does not teach "wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cxi) *'906 Patent, [132] "The optical system of claim 115, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator."*

1292. I previously analyzed Sparks in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.e.xix (Paragraphs 1117-1118).

I incorporate that analysis by reference.

(cxii) *'906 Patent, [133] "A method of performing dynamic wavelength separating and routing, comprising"*

1293. I previously analyzed Sparks in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]"discussed above in Section IX.1.e.xlviii (Paragraphs 1167-1169).

I incorporate that analysis by reference.

1294. To the extent the language in the preamble is considered limiting, Sparks discloses a "method" of performing dynamic wavelength separating and routing.

1295. Sparks discloses a method of separating and routing different signals or wavelengths to different inputs. "Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Sparks at 2:66-3:2. Further, Sparks discloses constantly controlling the power of the optical channels. "In wavelength division multiplexed (WDM) transmission, it is desirable to control the power of the individual optical channels or wavelengths. Channels could be controlled to provide constant system signal to noise ratio. One of the simplest methods of control is to maintain each of the power levels of the individual wavelength components (channels) at substantially the same level." Sparks at 1:20-26. Further, Sparks discloses controlling the beams to reflect them into any of the output fibers. For example, if light from a first input fiber is output at a first output fiber, light from a second input fiber can be added to the light output at the first input fiber. "By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array." Sparks at 4:33-38.

1296. Therefore, Sparks discloses to a POSITA a "method" of performing dynamic wavelength separating and routing. Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cxiii) *'906 Patent, [133-a] "receiving a multi-wavelength optical signal from a fiber collimator input port"*

1297. I previously analyzed Sparks in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.e.iii (Paragraphs 1067-1069); and
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.e.xlix (Paragraphs 1170-1173).

I incorporate that analysis by reference.

(cxiv) *'906 Patent, [133-b] "separating said multi-wavelength optical signal into multiple spectral channels"*

1298. I previously analyzed Sparks in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.e.vi (Paragraphs 1076-1078).

I incorporate that analysis by reference.

(cxv) *'906 Patent, [133-c] "focusing said spectral channels onto a spatial array of corresponding beam-deflecting elements, whereby each beam-deflecting element receives one of said spectral channels"*

1299. I previously analyzed Sparks in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.e.xvi (Paragraphs 1108-1110); and
- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels," discussed above in Section IX.1.e.vii (Paragraphs 1079-1086)

I incorporate that analysis by reference.

(cxvi) *’906 Patent, [133-d] “dynamically and continuously controlling said beam-deflecting elements in two dimensions to direct said spectral channels into any selected ones of output ports and to control the power of the spectral channels coupled into said selected output ports”*

1300. I previously analyzed Sparks in view of the following limitations:

- “each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]” discussed above in Section IX.1.e.vii (Paragraphs 1079-1086);

- “a control unit for controlling each of said beam-deflecting elements[,]” discussed above in Section IX.1.e.viii (Paragraphs 1087-1090);

- “a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]” discussed above in Section IX.1.e.ix (Paragraphs 1091-1093);

- “said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal[,]” discussed above in Section IX.1.e.xiv (Paragraphs 1104-1106);

- “controlling dynamically and continuously said beam-deflecting elements in two dimensions[,]”discussed above in Section IX.1.e.xli (Paragraphs 1154-1157);

- “a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port [,]” discussed above in Section IX.1.e.vii (Paragraphs 1079-1086); and

- “a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber

collimator output ports[,]" discussed above in Section IX.1.e.lii (Paragraphs 1179-1182)

I incorporate that analysis by reference.

(cxvii) *'906 Patent, [134] "The method of claim 133 further comprising the step of providing feedback control of said beam-deflecting elements to maintain a predetermining coupling of each spectral channel directed into one of said output ports."*

1301. I previously analyzed Sparks in view of the following limitations:

- "a spatial array of beam-deflecting elements[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086);
- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.e.ix (Paragraphs 1091-1093);
- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.e.x (Paragraphs 1094-1096);
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.e.xxii (Paragraphs 1125-1127); and
- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.e.liii (Paragraphs 1183-1188).

I incorporate that analysis by reference.

(cxviii) *'906 Patent, [135] "The method of claim 134 further comprising the step of maintaining power levels of said spectral channels directed into said output ports at a predetermining value."*

1302. I previously analyzed Sparks in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing

unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.e.ix (Paragraphs 1091-1093); and

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.e.x (Paragraphs 1094-1096).

I incorporate that analysis by reference.

(cxix) *'906 Patent, [137] "The method of claim 133 wherein a subset of said spectral channels is directed into one of said output ports, thereby providing one or more pass-through spectral channels."*

1303. I previously analyzed Sparks in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.e.vii (Paragraphs 1079-1086);

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.e.lii (Paragraphs 1179-1182); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels[,]"discussed above in Section IX.1.e.xciii (Paragraphs 1254-1255).

I incorporate that analysis by reference.

(cxx) *'906 Patent, [138] "The method of claim 137 further comprising the step of multiplexing said pass-through spectral channels with one or more add spectral channels, so as to provide an output optical signal."*

1304. I previously analyzed Sparks in view of the following limitations:

- "wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors [,]"discussed above in Section IX.1.e.cvi (Paragraph 1281).

I incorporate that analysis by reference.

(cxxi) *'906 Patent, [139] "The method of claim 133 wherein said beam-deflecting elements comprise an array of silicon micromachined mirrors."*

1305. I previously analyzed Sparks in view of the following limitations:

- "a spatial array of beam-deflecting elements[,]"discussed above in Section IX.1.e.vii (Paragraphs 1079-1086);
- "a spatial array of channel micromirrors[,] discussed above in Section IX.1.e.lii (Paragraphs 1179-1182); and
- "wherein each channel micromirror is a silicon micromachined mirror[,]" discussed above in Section IX.1.e.lvii (Paragraphs 1200-1202).

I incorporate that analysis by reference.

f) U.S. Patent No. 6,498,872 ("Bouevitch")

1306. Bouevitch is directed to "an optical device for rerouting and modifying an optical signal in accordance with the instant invention is shown that is capable of operating as a Dynamic Gain/Channel Equalizer (DGE) and/or a Configurable Optical Add/Drop Multiplexer (COADM)." Bouevitch at 5:15-19; *see also id.* at FIG. 11.

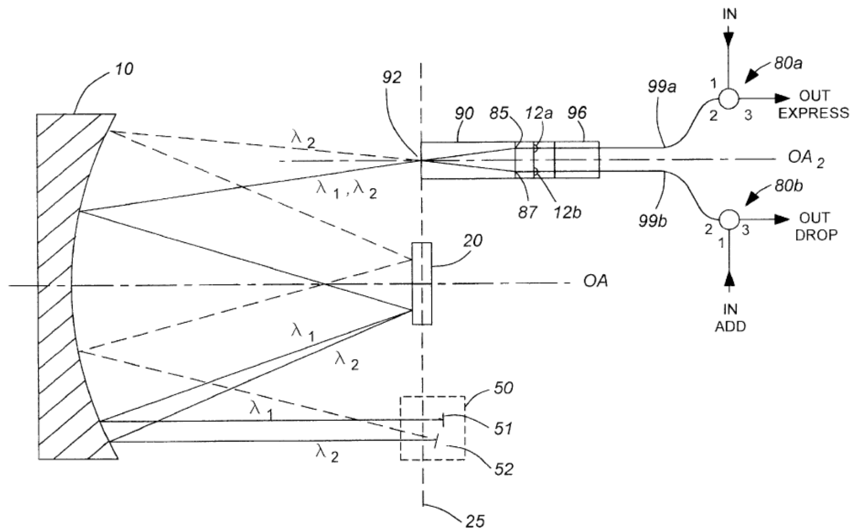


FIG. 11

(i) *Bouevitch Is Prior Art to the Asserted Claims*

1307. Bouevitch claims priority to U.S. Provisional Application No. 60/183,155 filed on February 17, 2000 was filed on December 05, 2000, was published as U.S. 2002/0009257 on January 24, 2002, and issued on December 24, 2002. Accordingly, Bouevitch is prior art to the ’905 and ’906 Patents under at least pre-AIA 35 U.S.C. § 102(e).

1308. Accordingly, it is my understanding that Bouevitch is prior art to the ’905 and ’906 Patents under at least pre-AIA 35 U.S.C. § 102(e).

(ii) *’905 Patent, [23-pre]: “An optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports, the apparatus comprising”*

1309. To the extent the language in the preamble is considered limiting, Bouevitch discloses “an optical add-drop apparatus comprising an output port and … an input port and one or more other ports.” To the extent Bouevitch does not teach “fiber collimators serving as[,]” these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1310. Bouevitch discloses an optical device with input ports and output ports. "Referring now to FIG. 1, an optical device for rerouting and modifying an optical signal in accordance with the instant invention is shown that is capable of operating as a Dynamic Gain/Channel Equalizer (DGE) and/or a Configurable Optical Add/Drop Multiplexer (COADM). … Two ports 102a and 102b are shown at an input/output end with bi-directional arrows indicating that light launched into port 102a can be transmitted through the optical device and can be reflected backward to the input port from which it was launched 102a, or alternatively, can be switched to port 102b or vice versa in a controlled manner. The input/output ports 102a and 102b are also disposed about one focal plane away from the element having optical power 110a to which they are optically coupled. Although only two input/output ports are shown to facilitate an understanding of this device, a plurality of such pairs of ports is optionally provided." Bouevitch at 5:15-38; *see also id.* at FIG. 1, 14:36-44, 14:55-15:1, FIG. 11, Bouevitch at Abstract, Bouevitch at 10:56-61 (discussing "other" ports). Bouevitch also discusses microlenses that correspond to collimators. Bouevitch at 14:14-21; *see also id.* at FIG. 11.

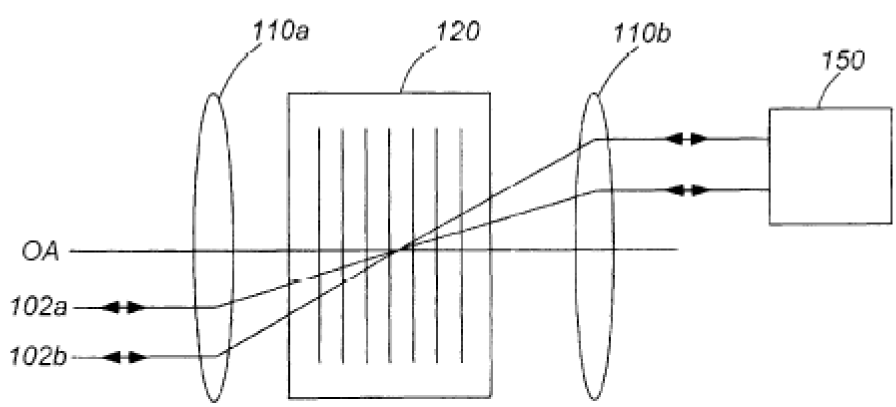


FIG. 1

1311. Therefore, under Capella's apparent interpretation, Bouevitch discloses to a POSITA "an optical add-drop apparatus comprising an output port and … an input port and one or more other ports." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Bouevitch does not teach "fiber collimators serving as[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

(iii) *'905 Patent, [23-a] "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels"*

1312. Under Capella's apparent interpretation, Bouevitch discloses "input port for an input multi-wavelength optical signal having first spectral channels." To the extent Bouevitch does not teach "fiber collimator[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1313. Bouevitch discloses an input port for a collimated beam of light. "A collimated beam of light having a predetermined polarization and carrying wavelengths λ1, λ2, . . . λ8 is launched through port 102 a to a lower region of lens 110 a and is redirected to the diffraction grating 120." Bouevitch at 8:10-13. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

1314. Therefore, under Capella's apparent interpretation, Bouevitch discloses to a POSITA "input port for an input multi-wavelength optical signal having first spectral channels." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Bouevitch does not teach "fiber collimator[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(iv) *'905 Patent, [23-b] "the fiber collimator one or more other ports for second spectral channels"*

1315. Under Capella's apparent interpretation, Bouevitch discloses "one or more other ports for second spectral channels." To the extent Bouevitch does not teach "fiber collimator[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1316. Bouevitch discloses a port for a second spectral channel. "***Simultaneously, a second beam of light having central wavelength λ2 is added into port 1 of the second optical circulator 80b and is circulated to optical waveguide 99b***. The second beam of light λ2 is transmitted through the microlens 12b to the lens 90, in a direction substantially parallel to the optical axis (λ2) of the lens 90. It enters the lens 90 through port 87 disposed off the optical axis (OA2) and emerges from port 92 coincident with the optical axis (OA2) at an angle to the optical axis. The emerging beam of light is transmitted to an upper portion of the spherical reflector 10, is reflected, and is incident on the diffraction grating 20, where it is reflected to reflector 52 of the MEMS array 50. Reflector 52 is orientated such that the second beam of light corresponding to λ2 is reflected back along a different optical path to the spherical reflector 10, where it is directed to the diffraction grating. At the diffraction grating, the added optical signal

corresponding to λ2 is combined with the express signal corresponding to λ1. The multiplexed signal is returned to the lens 90, passes through port 85, and returns to port 2 of the first circulator 80a where it is circulated out of the device from port 3." Bouevitch at 14:66-15:18 (emphasis added).

1317. Therefore, under Capella's apparent interpretation, Bouevitch discloses to a POSITA "one or more other ports for second spectral channels." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Bouevitch does not teach "fiber collimator[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(v) *'905 Patent, [23-c] "the output port for an output multi-wavelength optical signal"*

1318. Bouevitch discloses to a POSITA "the output port for an output multi-wavelength optical signal."

1319. Bouevitch discloses an output port that combines multiple optical signals. For example, Bouevitch discloses a "beam of light carrying wavelengths λ_1 and λ_2, is launched into port 1 of the first optical circulator 80a and is circulated to optical waveguide 99a" and "a second beam of light having central wavelength λ_2 is added into port 1 of the second optical circulator 80b and is circulated to optical waveguide 99b." Bouevitch at 14:39-15:1; *see also id.* at FIG. 11.

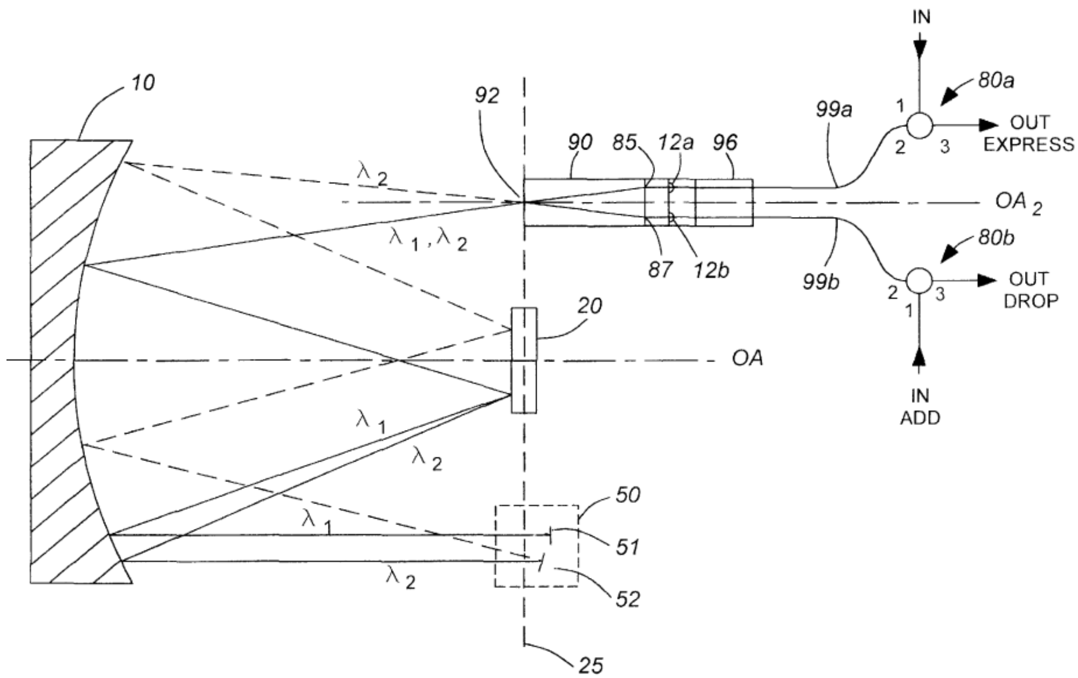


FIG. 11

1320. Therefore, Bouevitch discloses to a POSITA "the output port for an output multi-wavelength optical signal." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(vi) *'905 Patent, [23-d] "a wavelength-selective device for spatially separating said spectral channels"*

1321. Bouevitch discloses to a POSITA "a wavelength-selective device for spatially separating said spectral channels."

1322. Bouevitch discloses spatially separating beams of light: "[a] collimated beam of light having a predetermined polarization and carrying wavelengths λ1, λ2, .. λ8 is launched through port 102a to a lower region of lens 110a and is redirected to the diffraction grating 120. The beam of light is ***spatially dispersed*** (i.e., demultiplexed) according to wavelength in a direction perpendicular to the plane of the paper. The spatially dispersed beam of light is

transmitted as 8 sub-beams of light corresponding to 8 different spectral channels having central wavelengths λ1, λ2 , .. λ8 through lens 110b, where it is collimated and incident on the modifying means 150, which for exemplary purposes, is shown in FIG. 3a-b. Each sub-beam of light is passed through an independently controlled pixel in the liquid crystal array 130." Bouevitch at 8:10-23 (emphasis added). Bouevitch also discloses a wavelength-selective device or wavelength separator. Bouevitch at 14:48-53; *see also id.* at 8:10-22.

1323. Therefore, Bouevitch discloses to a POSITA "a wavelength-selective device for spatially separating said spectral channels." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(vii) *'905 Patent, [23-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port"*

1324. Bouevitch discloses "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable … to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port." To the extent Bouevitch does not teach "in two dimensions"[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1325. Bouevitch discloses controlling the reflection of light: "light launched into port 102a can be transmitted through the optical device and can be reflected backward to the input port from which it was launched 102a, or alternatively, can be switched to port 102b or vice versa in a ***controlled manner***. The input/output ports 102a and 102b are also disposed about one focal plane away from the element having optical power 110a to which they are optically coupled." Bouevitch at 5:15-38 (emphasis added). Bouevitch discloses controlling the angle at which light is deflected: ""The degree of attenuation is based on the degree of deflection provided by the reflector (i.e., the angle of reflection)." Bouevitch at 7:31-38; *see also id.* 14:48-55 (disclosing a MEMS mirror array; see also Bouevitch at 14:53-65, 10:43-51, FIG. 3. Bouevitch also discloses a pivotable MEMS array. "Moreover, it is also within the scope of the instant invention for the MEMs array to flip in either a horizontal or vertical direction, relative to the dispersion plane. Furthermore, any combination of the above embodiments and/or components are possible." Bouevitch at 15:30-34; *see also id.* at 14:5-65. Bouevitch also discusses the goal of controlling the MEMS mirror is to effect the add/drop process, which includes reflecting the spectral channels to selected add/drop ports. Bouevitch at 14:66-14:18. Bouevitch also discusses mirrors can be continuously pivotable. Bouevitch at 7:35-37; *see also id.* at 12:59-60.

1326. Therefore, Bouevitch discloses to a POSITA "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable … to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port." Even if Bouevitch does not do so, however, these limitations would

have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Bouevitch does not teach "in two dimensions[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(viii) *'905 Patent, [24] "The optical add-drop apparatus of claim 23 further comprising a control unit for controlling each of said beam-deflecting elements"*

1327. To the extent Bouevitch does not teach "a control unit for controlling each of said beam-deflecting elements[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(ix) *'905 Patent, [25] "The optical add-drop apparatus of claim 24, wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements"*

1328. To the extent Bouevitch does not teach "wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(x) *'905 Patent, [26] "The optical add-drop apparatus of claim 25, wherein said servo-control assembly maintains said power levels at predetermined values"*

1329. To the extent Bouevitch does not teach "wherein said servo-control assembly maintains said power levels at predetermined values[,]" these limitations would have been

within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xi) *'905 Patent, [27] "The optical add-drop apparatus of claim 24, wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal"*

1330. Bouevitch discloses "direct[ing] selected ones of said first spectral channels to one or more of said … other ports to be dropped as second spectral channels from said output multi-wavelength optical signal." To the extent Bouevitch does not teach a control unit or fiber collimators, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1331. Bouevitch discloses "The emerging beam of light λ1λ2, is transmitted to an upper portion of the spherical reflector 10, is reflected, and is incident on the diffraction grating 20, where it is spatially dispersed into two sub-beams of light carrying wavelengths λ1 and λ2, respectively. Each sub-beam of light is transmitted to a lower portion of the spherical reflector 10, is reflected, and is transmitted to separate reflectors 51 and 52 of the MEMS array 50. Referring to FIG. 11, reflector 51 is orientated such that the sub-beam of light corresponding to λ1 incident thereon, is reflected back along the same optical path to the lens 90, passes through port 85 again, and propagates to port 2 of circulator 80a where it is circulated to port 3. Reflector 52, however, is orientated such that the sub-beam of light corresponding to λ2 is reflected back along a different optical path. Accordingly, the dropped signal corresponding to wavelength λ2 is returned to the lens 90, passes through port 87, propagates to port 2 of the second circulator 80b, and is circulated to port 3." Bouevitch at 14:39-65.

1332. Therefore, Bouevitch discloses to a POSITA "direct[ing] selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Bouevitch does not teach a control unit or fiber collimators, limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xii) *'905 Patent, [28] "The optical add-drop apparatus of claim 24, wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal"*

1333. Bouevitch discloses "direct[ing] selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal." To the extent Bouevitch does not teach "a control unit[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1334. Bouevitch discloses reflecting a beam to an output port to be added to the output optical signal. "Reflector 52 is orientated such that the second beam of light corresponding to λ2 is reflected back along a different optical path to the spherical reflector 10, where it is directed to the diffraction grating. At the diffraction grating, the added optical signal corresponding to λ2 is combined with the express signal corresponding to λ1. The multiplexed signal is returned to the lens 90, passes through port 85, and returns to port 2 of the first circulator 80a where it is circulated out of the device from port 3." Bouevitch at 14:66-15:18.

1335. Therefore, Bouevitch discloses to a POSITA "direct[ing] selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Bouevitch does not teach a control unit[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xiii) *'905 Patent, [29] "The optical add-drop apparatus of claim 23 further comprising alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device"*

1336. To the extent Bouevitch does not teach "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. To the extent that "alignment" requires mirrors, a POSITA would have known to use mirrors for alignment. *See, e.g.*, Bouevitch at 10:9-10 and 64-65 (discussing alignment problems).

(xiv) *'905 Patent, [31] "The optical add-drop apparatus of claim 23, wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal"*

1337. Bouevitch discloses to a POSITA "wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal."

1338. Bouevitch discloses a reflected beam of light being combined with another signal to form an multi-wavelength optical signal. "Simultaneously, a second beam of light having central wavelength λ2 is added into port 1 of the second optical circulator 80b and is circulated to optical waveguide 99b. The second beam of light λ2 is transmitted through the microlens 12b to the lens 90, in a direction substantially parallel to the optical axis (λ2) of the lens 90. It enters the lens 90 through port 87 disposed off the optical axis (OA2) and emerges from port 92 coincident with the optical axis (OA2) at an angle to the optical axis. The emerging beam of light is transmitted to an upper portion of the spherical reflector 10, is reflected, and is incident on the diffraction grating 20, where it is reflected to reflector 52 of the MEMS array 50. Reflector 52 is orientated such that the second beam of light corresponding to λ2 is reflected back along a different optical path to the spherical reflector 10, where it is directed to the diffraction grating. At the diffraction grating, the added optical signal corresponding to λ2 is combined with the express signal corresponding to λ1. The multiplexed signal is returned to the lens 90, passes through port 85, and returns to port 2 of the first circulator 80a where it is circulated out of the device from port 3." Bouevitch at 14:66-15:18.

1339. Therefore, Bouevitch discloses to a POSITA "wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xv) *'905 Patent, [32] "The optical add-drop apparatus of claim 23, wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels"*

1340. Bouevitch discloses "wherein said … one or more other ports comprise a … add port and a … drop port for respectively adding second and dropping first spectral channels." To the extent Bouevitch does not teach "fiber collimator[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1341. Bouevitch discloses both add ports and drop ports. "[A] signal added at port 1 of the second circulator device propagates to port 3 of the second circulator in the second mode of operation and is not collected in the first mode of operation." Bouevitch at 14:33-34; *see also id.* at FIG. 11. "An express signal launched into port 1 of the circulator 80a propagates to port 3 of the same circulator 80a in a first mode of operation and a dropped signal launched into port one of the circulator 80a propagates to port 3 of the second circulator 80b in a second mode of operation." Bouevitch at 14:28-32; *see also id.* at FIG. 11.

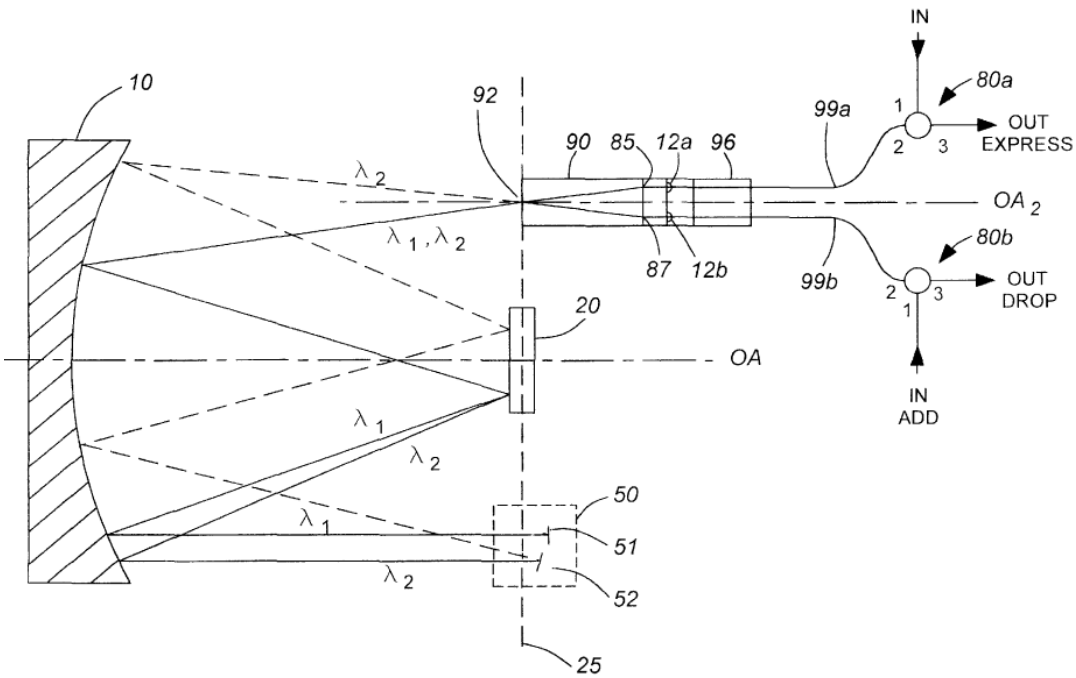


FIG. 11

1342. Therefore, Bouevitch discloses to a POSITA "wherein said … one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Bouevitch does not teach "fiber collimator[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xvi) *'905 Patent, [33] "The optical add-drop apparatus of claim 23 further comprising a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements"*

1343. Bouevitch discloses to a POSITA "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements."

1344. Bouevitch discloses focusing input and output optical waveguides. "Preferably, light transmitted to and from the output 998 and input 9999 optical waveguides is focused/collimated." Bouevitch at 13:10-11.

1345. Therefore, Bouevitch discloses to a POSITA "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xvii) *'905 Patent, [34] "The optical add-drop apparatus of claim 23, wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms"*

1346. Bouevitch discloses to a POSITA "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."

1347. Bouevitch discloses the use of diffraction elements. "The optical design includes a diffraction element 120 disposed between and at a focal plane of identical elements 110a and 110b having optical power, respectively." Bouevitch at 5:20-22. To the extent Bouevitch does not teach "ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1348. Therefore, Bouevitch discloses to a POSITA "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms." Even if Bouevitch does not do so, however, these limitations would have been within

the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xviii) *'905 Patent, [35] "The optical add-drop apparatus of claim 23, wherein said beam-deflecting elements comprise micromachined mirrors"*

1349. Bouevitch discloses to a POSITA "wherein said beam-deflecting elements comprise micromachined mirrors."

1350. Bouevitch discloses a reflector on a MEMS device. "FIG. 5 is a schematic diagram of another embodiment of the modifying means 150 including a micro electromechanical switch (MEMS) 155, which is particularly useful when the device is used as a DGE … After passing through the quarter waveplate 157, the beam of light becomes circularly polarized and is incident on a predetermined reflector of the MEMS array 155." Bouevitch at 7:23-34. To the extent Bouevitch does not teach "micromachined mirrors[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1351. Therefore, Bouevitch discloses to a POSITA "wherein said beam-deflecting elements comprise micromachined mirrors." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xix) *'905 Patent, [37] "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator"*

1352. To the extent Bouevitch does not teach "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]" these limitations would have been within the common

knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(xx)** *'905 Patent, [39] "The optical add-drop apparatus of claim 23, wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array"*

1353. To the extent Bouevitch does not teach "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(xxi)** *'905 Patent, [44] "The optical add-drop apparatus of claim 23, further comprising a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels"*

1354. Bouevitch discloses to a POSITA "a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels."

1355. Bouevitch discloses a modifying means to modify at least a portion of a light beam. "The input/output ports 102a and 102b are also disposed about one focal plane away from the element having optical power 110a to which they are optically coupled. Although only two input/output ports are shown to facilitate an understanding of this device, a plurality of such pairs of ports is optionally provided. At the other end of the device, modifying means 150 for modifying at least a portion of the light incident thereon is provided about the focal plane of the element having optical power 110b." Bouevitch at 5:29-38.

1356. Therefore, Bouevitch discloses to a POSITA "a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels." Even if Bouevitch does not do so, however, these limitations would have

been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(xxii)** *'905 Patent, [45] "The optical add-drop apparatus of claim 44, wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port"*

1357. Bouevitch discloses to a POSITA "wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port."

1358. Bouevitch discloses displacement of input and output light beams to affect coupling efficiency. "The lateral displacement of the input and modified output beams of light (i.e., as opposed to angular displacement) allows for highly efficient coupling between a plurality of input/output waveguides." Bouevitch at 7:60-64.

1359. Therefore, Bouevitch discloses to a POSITA "wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(xxiii)** *'905 Patent, [46] "The optical add-drop apparatus of claim 23, wherein the beam-deflecting elements are micromirrors"*

1360. Bouevitch discloses to a POSITA "wherein the beam-deflecting elements are micromirrors."

1361. Bouevitch discloses reflectors on a MEMS array. "[T]he beam of light becomes circularly polarized and is incident on a predetermined reflector of the MEMS array 155." Bouevitch at 7:31-34. To the extent Bouevitch does not teach "micromirrors[,]" these

limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1362. Therefore, Bouevitch discloses to a POSITA "wherein the beam-deflecting elements are micromirrors." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxiv) *'905 Patent, [47-pre] "An optical add-drop apparatus, comprising"*

1363. I previously analyzed Bouevitch in view of the following limitations:

- "[a]n optical add-drop apparatus," discussed above in Section IX.1.f.ii (Paragraphs 1308-1310).

I incorporate that analysis by reference.

(xxv) *'905 Patent, [47-a] "a fiber collimator serving as an input port for an input multi-wavelength optical signal having multiple spectral channels"*

1364. I previously analyzed Bouevitch in view of the following limitations:

- "fiber collimators serving as an input port . . . ," discussed above in Section IX.1.f.ii (Paragraphs 1308-1310); and
- "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels[,]" discussed above in Section IX.1.f.iii (Paragraphs 1311-1313).

I incorporate that analysis by reference.

(xxvi) *'905 Patent, [47-b] "an output port for an output multi-wavelength optical signal"*

1365. I previously analyzed Bouevitch in view of the following limitations:

- "an output port . . . ," discussed above in Section IX.1.f.ii (Paragraphs 1308-1310); and
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.f.v (Paragraphs 1317-1319).

I incorporate that analysis by reference.

(xxvii) *'905 Patent, [47-c] "one or more fiber collimators serving as one or more drop ports for selected spectral channels dropped from said multi-wavelength optical signal"*

1366. I previously analyzed Bouevitch in view of the following limitations:

- "fiber collimators serving as . . . one or more other ports . . . ," discussed above in Section IX.1.f.ii (Paragraphs 1308-1310);
- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.f.xi (Paragraphs 1329-1331);
- "wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.f.xv (Paragraphs 1339-1341).

I incorporate that analysis by reference.

(xxviii) *'905 Patent, [47-d] "a wavelength-selective device for spatially separating said multiple spectral channels"*

1367. I previously analyzed Bouevitch in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.f.vi (Paragraphs 1320-1322).

I incorporate that analysis by reference.

(xxix) *'905 Patent, [47-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports and to control the power of the spectral channel reflected to said output port of the fiber collimator serving as said selected port, whereby a subset of said spectral channels is directed to said fiber collimator serving as said drop ports"*

1368. I previously analyzed Bouevitch in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of

said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325);

- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.f.xi (Paragraphs 1329-1331); and
- "wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.f.xv (Paragraphs 1339-1341).

I incorporate that analysis by reference.

(xxx) *'905 Patent, [48] "The optical add-drop apparatus of claim 47, wherein none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"*

1369. I previously analyzed Bouevitch in view of the following limitations:

- "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]" discussed above in Section IX.1.f.xix (Paragraph 1351).

I incorporate that analysis by reference.

(xxxi) *'905 Patent, [49] "An optical add-drop apparatus, comprising"*

1370. I previously analyzed Bouevitch in view of the following limitations:

- "[a]n optical add-drop apparatus[,]" discussed above in Section IX.1.f.ii (Paragraphs 1308-1310).

I incorporate that analysis by reference.

(xxxii) *'905 Patent, [49-a] "a fiber collimator serving as an input port for an input multi-wavelength optical signal having multiple spectral channels"*

1371. I previously analyzed Bouevitch in view of the following limitations:

- "fiber collimators serving as an input port . . .[,]" discussed above in Section IX.1.f.ii (Paragraphs 1308-1310); and
- "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels[,]" discussed above in Section IX.1.f.iii (Paragraphs 1311-1313).

I incorporate that analysis by reference.

(xxxiii) *'905 Patent, [49-b] "an output port for an output multi-wavelength optical signal"*

1372. I previously analyzed Bouevitch in view of the following limitations:

- "an output port . . . ," discussed above in Section IX.1.f.ii (Paragraphs 1308-1310); and
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.f.v (Paragraphs 1317-1319).

I incorporate that analysis by reference.

(xxxiv) *'905 Patent, [49-c] "one or more fiber collimators serving as one or more add ports for selected spectral channels to be added to said output multi-wavelength optical signal"*

1373. I previously analyzed Bouevitch in view of the following limitations:

- "fiber collimators serving as . . . one or more other ports . . . ," discussed above in Section IX.1.f.ii (Paragraphs 1308-1310);
- "direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.f.xii (Paragraphs 1332-1334); and
- "wherein said fiber collimator one or more other ports comprise a fiber collimator add port . . for respectively adding second . . . spectral channels[,]" discussed above in Section IX.1.f.xv (Paragraphs 1339-1341).

I incorporate that analysis by reference.

(xxxv) *'905 Patent, [49-d] "a wavelength-selective device for reflecting said multiple and said selected spectral channels"*

1374. I previously analyzed Bouevitch in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.f.vi (Paragraphs 1320-1322).

I incorporate that analysis by reference.

1375. Bouevitch discloses to a POSITA "a wavelength-selective device for reflecting said multiple and said selected spectral channels."

1376. Bouevitch discloses selectively modifying and reflecting light beams off of a reflective surface. "FIGS. 4a and 4b are schematic diagrams showing another embodiment of the modifying means 150, wherein a birefringent crystal 152 is disposed before the liquid crystal array 130. A beam of light having a predetermined polarization state launched from port 102 a is dispersed into sub-beams, which are passed through the birefringent crystal 152. The sub-beams of light passing through the birefringent crystal 152 remain unchanged with respect to polarization. The sub-beams of light are transmitted through the liquid crystal array 130, where they are selectively modified, and reflected back to the birefringent crystal 152 via reflective surface 142." Bouevitch at 7:1-12; *see also id.* at FIGS. 4a-4b.

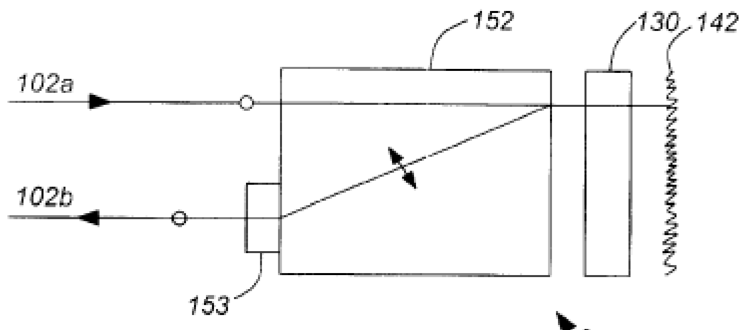


FIG. 4a

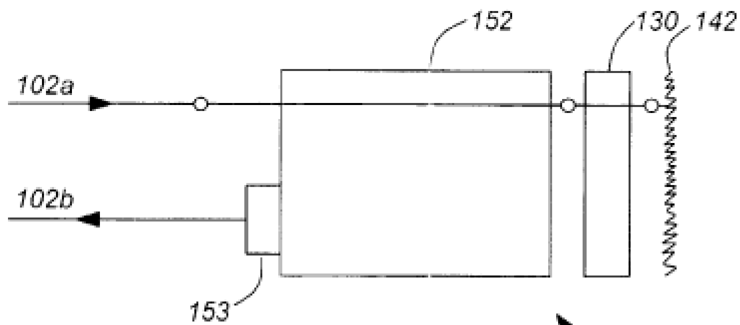


FIG. 4b

1377. Therefore, Bouevitch discloses to a POSITA "a wavelength-selective device for reflecting said multiple and said selected spectral channels." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(xxxvi)** *'905 Patent, [49-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports and to control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port, whereby said spectral channels from said fiber collimators serving as said add ports are selectively provided to said output port"*

1378. I previously analyzed Bouevitch in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325);

- "direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.f.xii (Paragraphs 1332-1334); and

- "wherein said fiber collimator one or more other ports comprise a fiber collimator add port . . for respectively adding second . . . spectral channels[,]" discussed above in Section IX.1.f.xv (Paragraphs 1339-1341).

I incorporate that analysis by reference.

(xxxvii) *'905 Patent, [50] "The optical add-drop apparatus of claim 49, wherein none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"*

1379. I previously analyzed Bouevitch in view of the following limitations:

- "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]" discussed above in Section IX.1.f.xix (Paragraph 1351).

I incorporate that analysis by reference.

(xxxviii) *'905 Patent, [51-pre] "A method of performing dynamic add and drop in a WDM optical network, comprising"*

1380. I previously analyzed Bouevitch in view of the following limitations:

- "[a]n optical add-drop apparatus[,]" discussed above in Section IX.1.f.ii (Paragraphs 1308-1310);

- "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.f.xi (Paragraphs 1329-1331); and

- "the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.f.xii (Paragraphs 1332-1334).

I incorporate that analysis by reference.

1381. To the extent the language in the preamble is considered limiting, Bouevitch discloses "[a] method of performing dynamic add … in a WDM optical network."

1382. Bouevitch discloses adding and dropping in a WDM network. "Dense WDM systems require special add/drop multiplexers (ADM) to add and drop particular channels (i.e., wavelengths)." Bouevitch at 1:25-27. Bouevitch discloses dynamically adjusting the beam using variable attenuation. "Variable attenuation is provided by the modifying means 950." Bouevitch at 12:59-60; *see also id.* at 3:22-23, 14:48-53, 8:10-22, 2:24-25.

1383. Therefore, Bouevitch discloses to a POSITA "[a] method of performing dynamic add … in a WDM optical network." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxxix) *'905 Patent, [51-a] "separating an input multi-wavelength optical signal into spectral channels"*

1384. I previously analyzed Bouevitch in view of the following similar limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.f.vi (Paragraphs 1320-1322).

I incorporate that analysis by reference.

(xl) *'905 Patent, [51-b] "imaging each of said spectral channels onto a corresponding beam-deflecting element"*

1385. I previously analyzed Bouevitch in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channel[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325); and

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.f.xvi (Paragraphs 1342-1344).

I incorporate that analysis by reference.

(xli) *'905 Patent, [51-c] "controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal"*

1386. I previously analyzed Bouevitch in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325);

- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.f.viii (Paragraph 1326);

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.f.ix (Paragraph 1327); and

- "said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal[,]" discussed above in Section IX.1.f.xiv (Paragraphs 1336-1338) and

I incorporate that analysis by reference.

1387. To the extent the language in the preamble is considered limiting, Bouevitch discloses "controlling dynamically . . . said beam deflecting elements."

1388. Bouevitch discloses dynamically adjusting the beam using variable attenuation of the beam deflecting elements. "Variable attenuation is provided by the modifying means 950." Bouevitch at 12:59-60; *see also id.* at 3:22-23, 2:24-25.

1389. Therefore, Bouevitch discloses to a POSITA "controlling dynamically . . . said beam deflecting elements." Even if Sparks does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xlii) *'905 Patent, [51-d] "receiving the output multi-wavelength optical signal at an output port that transmits the output multi-wavelength optical signal to an optical fiber; and wherein"*

1390. I previously analyzed Bouevitch in view of the following limitations:

- "an output port[,]" discussed above in Section IX.1.f.ii (Paragraphs 1308-1310);
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.f.v (Paragraphs 1317-1319); and
- "each of said elements . . . reflect[ing] its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325).

I incorporate that analysis by reference.

1391. Bouevitch discloses the optical signal having multiple wavelengths light. "A collimated beam of light having a predetermined polarization and carrying wavelengths λ1, λ2, . . . λ8 is launched through port 102 a to a lower region of lens 110 a and is redirected to the diffraction grating 120." Bouevitch at 8:10-13. Bouevitch also discloses to a POSITA "an output port that transmits the output multi-wavelength optical signal to an optical fiber." Bouevitch at 12:64-67.

1392. Bouevitch discloses an output optical fiber. "The attenuated output beam of light is passed through the lens 990, and is directed towards output port 987 where it is transmitted to output optical fibre 998." Bouevitch at 64-67.

1393. Therefore, Bouevitch discloses to a POSITA "an output port that transmits the output multi-wavelength optical signal to an optical fiber an output port that transmits the output

multi-wavelength optical signal to an optical fiber." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xliii) *'905 Patent, [51-e] "said selected ones of said spectral channels comprises a subset of said spectral channels, such that other non-selected ones of said spectral channels are dropped from said output multi-wavelength optical signal; and"*

1394. I previously analyzed Bouevitch in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325);
- "direct[ing] selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.f.xi (Paragraphs 1329-1331); and
- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.f.xv (Paragraphs 1339-1341).

I incorporate that analysis by reference.

(xliv) *'905 Patent, [51-f] "said controlling comprises reflecting said non-selected ones of said spectral channels to one or more fiber collimator serving as drop ports"*

1395. I previously analyzed Bouevitch in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.f.viii (Paragraph 1326);
- "direct[ing] selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.f.xi (Paragraphs 1329-1331); and

- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.f.xv (Paragraphs 1339-1341).

I incorporate that analysis by reference.

(xlv) *'905 Patent, [52] "The method of claim 51 further comprising imaging other spectral channels onto other corresponding beam-deflecting elements, and controlling dynamically and continuously said other beam-deflecting elements so as to combine said other spectral channels with said selected ones of said spectral channels into said output multi-wavelength optical signal"*

1396. I previously analyzed Bouevitch in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.f.viii (Paragraph 1326);
- "direct[ing] selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.f.xii (Paragraphs 1332-1334); and
- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.f.xv (Paragraphs 1339-1341).
- "controlling dynamically . . . beam-deflecting elements[,]" discussed above in Section IX.1.f.xli (Paragraphs 1385-1388).

I incorporate that analysis by reference.

(xlvi) *'905 Patent, [53] "The method of claim 51, wherein said imaging comprises focusing said spectral channels onto said beam-deflecting elements"*

1397. I previously analyzed Bouevitch in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325); and

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.f.xvi (Paragraphs 1342-1344).

I incorporate that analysis by reference.

(xlvii) *'905 Patent, [54] "The method of claim 51 further comprising monitoring a power level in one or more of said selected ones of said spectral channels, and controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring"*

1398. I previously analyzed Bouevitch in view of the following limitations:

- "a spectral monitor for monitoring said power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.f.ix (Paragraph 1327).

I incorporate that analysis by reference.

1399. I previously analyzed Bouevitch in view of the following limitations:

- "a spectral monitor for monitoring said power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.f.ix (Paragraph 1327).

I incorporate that analysis by reference.

(xlviii) *'906 Patent, [68-pre] "A wavelength-separating-routing apparatus, comprising"*

1400. To the extent that the preamble is considered limiting, Bouevitch discloses to a POSITA "a wavelength-separating-routing apparatus."

1401. Bouevitch discloses an apparatus that separate and routes light. "In accordance with the instant invention there is provided an optical device comprising: a first port for launching a beam of light; first redirecting means disposed substantially one focal length away from the first port for receiving the beam of light, the first redirecting means having optical power; a dispersive element disposed substantially one focal length away from the first

redirecting means for dispersing the beam of light into a plurality of sub-beams of light; second redirecting means disposed substantially one focal length away from the dispersive element for receiving the dispersed beam of light, the second redirecting means having optical power; and, modifying means optically disposed substantially one focal length away from the second redirecting means for selectively modifying each sub-beam of light and for reflecting each of the modified sub-beams back to the second redirecting means, wherein each sub-beam of light is incident on and reflected from the modifying means along substantially parallel optical paths." Bouevitch at 2:44-62.

1402. Therefore, Bouevitch discloses to a POSITA "a wavelength-separating-routing apparatus." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xlix) *'906 Patent, [68-a] "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports"*

1403. I previously analyzed Bouevitch in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.f.iii (Paragraphs 1311-1313).

I incorporate that analysis by reference.

1404. Under Capella's apparent interpretation, to the extent Bouevitch does not teach "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. To the extent that "fiber collimator" port requires a collimator and a port

in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

(l) *'906 Patent, [68-b] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

1405. I previously analyzed Bouevitch in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.f.vi (Paragraphs 1320-1322).

I incorporate that analysis by reference.

(li) *'906 Patent, [68-c] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

1406. I previously analyzed Bouevitch in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.f.xvi (Paragraphs 1342-1344).

I incorporate that analysis by reference.

1407. Bouevitch discloses to a POSITA channels that are focused onto "corresponding spectral spots."

1408. Bouevitch discloses optical elements (110a, 110b, and 120 in FIG. 1 below) that can focus a beam onto corresponding spectral spots. "The optical design includes a diffraction element 120 disposed between and at a focal plane of identical elements 110a and 110b having optical power, respectively. Two ports 102a and 102b are shown at an input/output end with bi-directional arrows indicating that light launched into port 102a can be transmitted through the optical device and can be reflected backward to the input port from which it was launched 102a, or alternatively, can be switched to port 102b or vice versa in a controlled manner. The input/output ports 102a and 102b are also disposed about one focal plane away from the element having optical power 110a to which they are optically coupled. Although only two

input/output ports are shown to facilitate an understanding of this device, a plurality of such pairs of ports is optionally provided. At the other end of the device, modifying means 150 for modifying at least a portion of the light incident thereon is provided about the focal plane of the element having optical power 110b." Bouevitch at 5:15-38; *see also id.* at FIG. 1.

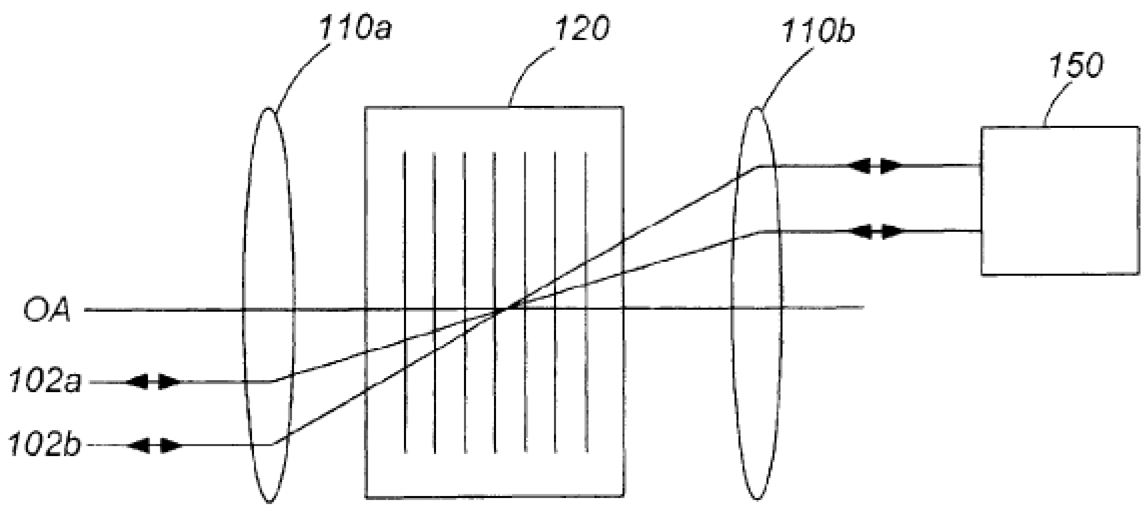


FIG. 1

1409. Therefore, Bouevitch discloses to a POSITA channels that are focused onto "corresponding spectral spots." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lii) *'906 Patent, [68-d] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports"*

1410. I previously analyzed Bouevitch in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325).

I incorporate that analysis by reference.

1411. To the extent Bouevitch does not teach ""channel micromirrors" are disclosed and that they are "pivotal about two axes"[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(liii) *'906 Patent, [69] "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports"*

1412. I previously analyzed Bouevitch in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.f.ix (Paragraph 1327);

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.f.x (Paragraph 1328); and
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.f.xxii (Paragraphs 1356-1358).

I incorporate that analysis by reference.

1413. Bouevitch discloses to a POSITA channels that are focused onto "a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports."

1414. Bouevitch discloses a modifying means that can control the angle of a reflected beam. "Each sub-beam of the spatially dispersed beam of light is selectively reflected back to the spherical reflector 910 at a predetermined angle, generally along a different optical path from which it came. Variable attenuation is provided by the modifying means 950." Bouevitch at 12:55-60. Bouevitch also discloses a pivotable MEMS array. "Moreover, it is also within the scope of the instant invention for the MEMs array to flip in either a horizontal or vertical direction, relative to the dispersion plane. Furthermore, any combination of the above embodiments and/or components are possible." Bouevitch at 15:30-34; *see also id.* at 14:5-65.

1415. Therefore, Bouevitch discloses to a POSITA channels that are focused onto "a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports." Even if Bouevitch does not do so, however, these limitations would

have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(liv)** *'906 Patent, [70] "The wavelength-separating-routing apparatus of claim 69 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

1416. I previously analyzed Bouevitch in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.f.ix (Paragraph 1327).

I incorporate that analysis by reference.

1417. To the extent Bouevitch does not teach "a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(lv)** *'906 Patent, [71] "The wavelength-separating-routing apparatus of claim 70 wherein said servo-control assembly maintains said power levels at a predetermined value."*

1418. I previously analyzed Bouevitch in view of the following limitations:

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]" discussed above in Section IX.1.f.x (Paragraph 1328).

I incorporate that analysis by reference.

> **(lvi)** *'906 Patent, [72] "The wavelength-separating-routing apparatus of claim 68 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."*

1419. I previously analyzed Bouevitch in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device[,]"discussed above in Section IX.1.f.xiii (Paragraph 1335); and
- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.f.xlvii (Paragraphs 1397-1398).

I incorporate that analysis by reference.

1420. To the extent Bouevitch does not teach "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(lvii)** *'906 Patent, [79] "The wavelength-separating-routing apparatus of claim 68 wherein each channel micromirror is a silicon micromachined mirror."*

1421. To the extent Bouevitch does not teach "wherein each channel micromirror is a silicon micromachined mirror[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lviii) *'906 Patent, [80] "The wavelength-separating-routing apparatus of claim 68 wherein said fiber collimator input and output ports are arranged in a one-dimensional array."*

1422. I previously analyzed Bouevitch in view of the following limitations:

- "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array[,]"discussed above in Section IX.1.f.xx (Paragraph 1352).

I incorporate that analysis by reference.

(lix) *'906 Patent, [81] "The wavelength-separating-routing apparatus of claim 68 wherein said beam-focuser comprises a focusing lens having first and second focal points."*

1423. Bouevitch discloses to a POSITA "wherein said beam-focuser comprises a focusing lens having first and second focal points."

1424. Bouevitch discloses optical elements (110a, 110b in FIG. 1 below) that can focus a beam onto separate focal points. "The optical design includes a diffraction element 120 disposed between and at a focal plane of identical elements 110a and 110b having optical power, respectively. Two ports 102a and 102b are shown at an input/output end with bi-directional arrows indicating that light launched into port 102a can be transmitted through the optical device and can be reflected backward to the input port from which it was launched 102a, or alternatively, can be switched to port 102b or vice versa in a controlled manner. The input/output ports 102a and 102b are also disposed about one focal plane away from the element having optical power 110a to which they are optically coupled. Although only two input/output ports are shown to facilitate an understanding of this device, a plurality of such pairs of ports is optionally provided. At the other end of the device, modifying means 150 for modifying at least a portion of the light incident thereon is provided about the focal plane of the element having optical power 110b." Bouevitch at 5:15-38; *see also id.* at FIG. 1. Bouevitch

also discloses a one-dimensional array of fiber collimators. Bouevitch at 6:1-5; *see also id.* at 13:9-18, 5:22-42, FIGS. 2a-2b, 9b-9d.

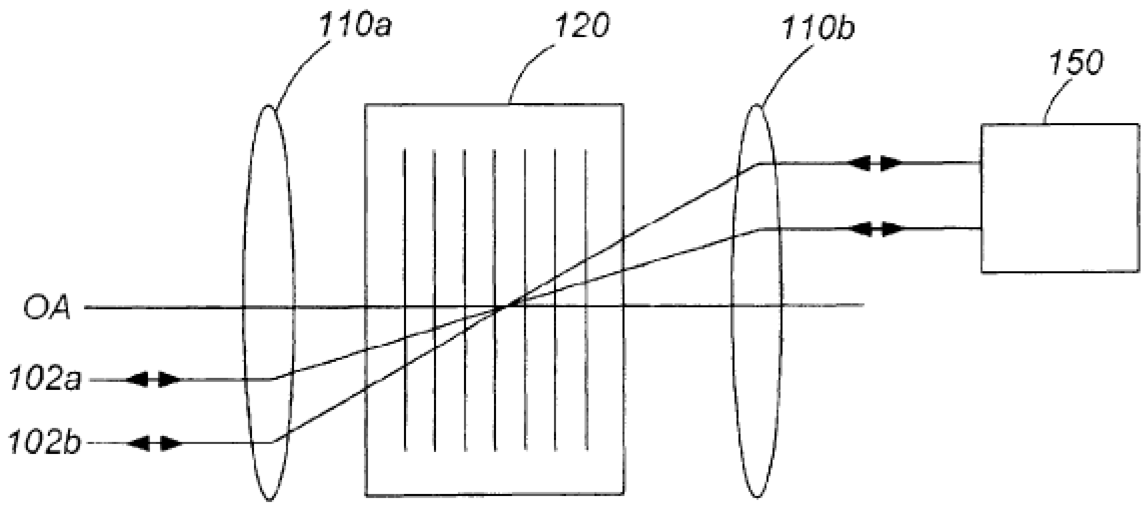


FIG. 1

1425. Therefore, Bouevitch discloses to a POSITA ""wherein said beam-focuser comprises a focusing lens having first and second focal points." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lx) *'906 Patent, [82] "The wavelength-separating-routing apparatus of claim 81 wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens."*

1426. Bouevitch discloses to a POSITA "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens."

1427. Bouevitch discloses dispersing or separating a beam of light into sub-beams. "FIGS. 4a and 4b are schematic diagrams showing another embodiment of the modifying means 150, wherein a birefringent crystal 152 is disposed before the liquid crystal array 130. ***A beam of light having a predetermined polarization state launched from port 102 a is dispersed into sub-beams***, which are passed through the birefringent crystal 152. The sub-beams of light passing through the birefringent crystal 152 remain unchanged with respect to polarization. The sub-beams of light are transmitted through the liquid crystal array 130, where they are selectively modified, and reflected back to the birefringent crystal 152 via reflective surface 142." Bouevitch at 7:1-12 (emphasis added); *see also id.* at FIGS. 4a-4b.

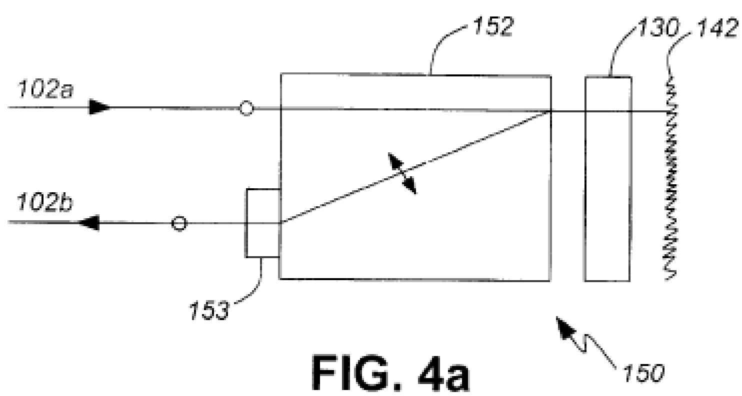


FIG. 4a

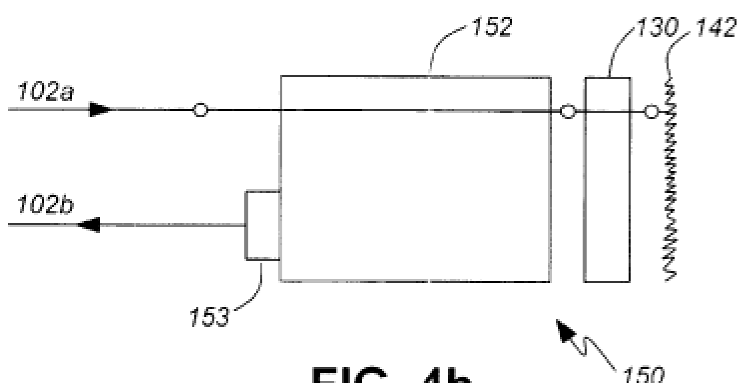


FIG. 4b

1428. Bouevitch also discloses optical elements (110a, 110b in FIG. 1 below) that can focus a beam onto separate focal points. "The optical design includes a diffraction element 120

disposed between and at a focal plane of identical elements 110a and 110b having optical power, respectively. Two ports 102a and 102b are shown at an input/output end with bi-directional arrows indicating that light launched into port 102a can be transmitted through the optical device and can be reflected backward to the input port from which it was launched 102a, or alternatively, can be switched to port 102b or vice versa in a controlled manner. The input/output ports 102a and 102b are also disposed about one focal plane away from the element having optical power 110a to which they are optically coupled. Although only two input/output ports are shown to facilitate an understanding of this device, a plurality of such pairs of ports is optionally provided. At the other end of the device, modifying means 150 for modifying at least a portion of the light incident thereon is provided about the focal plane of the element having optical power 110b." Bouevitch at 5:15-38; *see also id.* at FIG. 1.

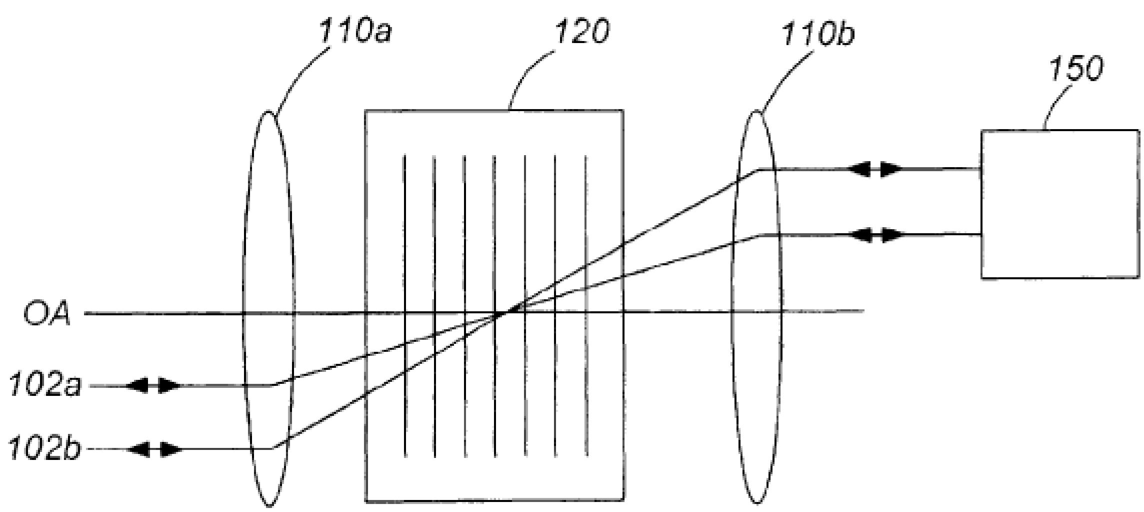


FIG. 1

1429. Therefore, Bouevitch discloses to a POSITA "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of

said focusing lens." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxi) *'906 Patent, [83] "The wavelength-separating-routing apparatus of claim 68 wherein said beam-focuser comprises an assembly of lenses."*

1430. Bouevitch discloses to a POSITA "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens."

1431. Bouevitch also discloses multiple optical elements (110a, 110b in FIG. 1 below) that can focus a beam. "The optical design includes a diffraction element 120 disposed between and at a focal plane of identical elements 110a and 110b having optical power, respectively. Two ports 102a and 102b are shown at an input/output end with bi-directional arrows indicating that light launched into port 102a can be transmitted through the optical device and can be reflected backward to the input port from which it was launched 102a, or alternatively, can be switched to port 102b or vice versa in a controlled manner. The input/output ports 102a and 102b are also disposed about one focal plane away from the element having optical power 110a to which they are optically coupled. Although only two input/output ports are shown to facilitate an understanding of this device, a plurality of such pairs of ports is optionally provided. At the other end of the device, modifying means 150 for modifying at least a portion of the light incident thereon is provided about the focal plane of the element having optical power 110b." Bouevitch at 5:15-38; *see also id.* at FIG. 1.

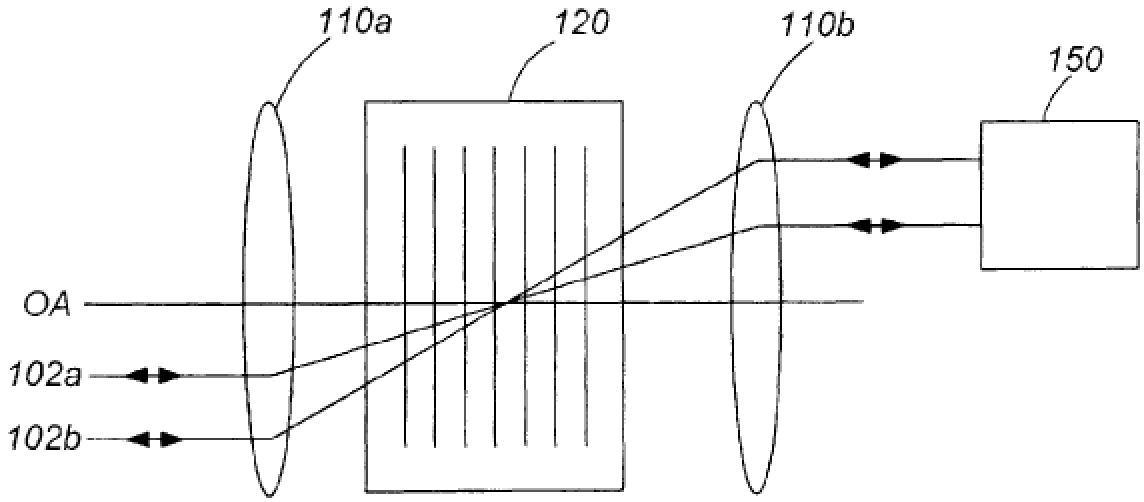


FIG. 1

1432. Therefore, Bouevitch discloses to a POSITA "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxii) *'906 Patent, [84] "The wavelength-separating-routing apparatus of claim 68 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing gratings."*

1433. I previously analyzed Bouevitch in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.f.xvii (Paragraphs 1345-1347).

I incorporate that analysis by reference.

(lxiii) *'906 Patent, [85] "The wavelength-separating-routing apparatus of claim 68 further comprising a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors."*

1434. Bouevitch discloses to a POSITA "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors."

1435. Bouevitch discloses a quarter wave plate interposed between a birefringent element and a reflector on a MEMs array. "A beam of light having a predetermined polarization state launched from port 102 a is dispersed into sub-beams and is passed through a birefringent element 156 and quarter waveplate 157. The birefringent element 156 is arranged not to affect the polarization of the sub-beam of light. After passing through the quarter waveplate 157, the beam of light becomes circularly polarized and is incident on a predetermined reflector of the MEMS array 155. The reflector reflects the sub-beam of light incident thereon back to the quarter waveplate." Bouevitch at 7:23-35; *see also id.* at FIG. 5 (element 157).

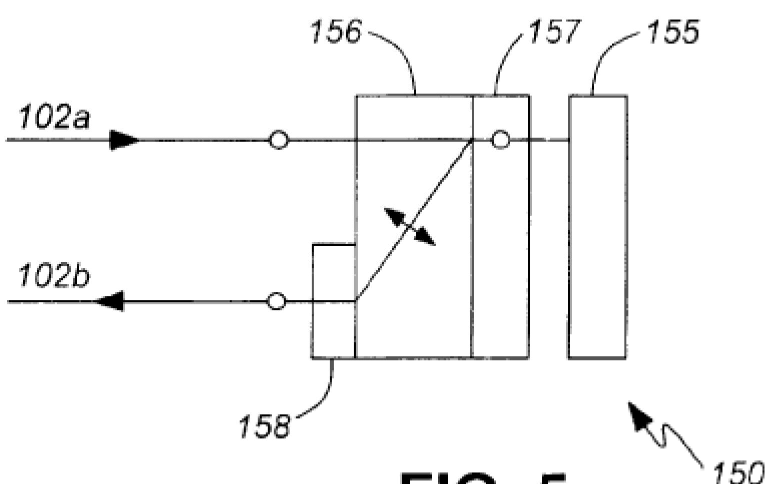


FIG. 5

1436. Therefore, Bouevitch discloses to a POSITA "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors." Even if

Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Bouevitch does not teach "fiber collimator[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxiv) *'906 Patent, [86] "The wavelength-separating-routing apparatus of claim 68 wherein each fiber collimator output port carries a single one of said spectral channels."*

1437. Under Capella's apparent interpretation, Bouevitch discloses "wherein each fiber collimator output port carries a single one of said spectral channels."

1438. Bouevitch discloses light being separated and reflected into corresponding ports. Bouevitch at 14:27-15:18.

1439. Therefore, under Capella's apparent interpretation, Bouevitch discloses to a POSITA "wherein each fiber collimator output port carries a single one of said spectral channels." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

(lxv) *'906 Patent, [87] "The wavelength-separating-routing apparatus of claim 86 further comprising one or more optical sensors, optically coupled to said fiber collimator output ports."*

1440. To the extent Bouevitch does not teach "one or more optical sensors, optically coupled to said fiber collimator output ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxvi) *'906 Patent, [88] "The wavelength-separating-routing apparatus of claim 68, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator."*

1441. I previously analyzed Bouevitch in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.f.xix (Paragraph 1351).

I incorporate that analysis by reference.

(lxvii) *'906 Patent, [89-pre] "A servo-based optical apparatus comprising"*

1442. I previously analyzed Bouevitch in view of the following limitations:

- "An optical . . . apparatus[,]" discussed above in Section IX.1.f.ii (Paragraphs 1308-1310);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.f.viii (Paragraph 1326); and
- "wherein the control unit further comprises a servo-control assembly[,]" discussed above in Section IX.1.f.ix (Paragraph 1327).

I incorporate that analysis by reference.

(lxviii) *'906 Patent, [89-a] "multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports"*

1443. I previously analyzed Bouevitch in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.f.ii (Paragraphs 1308-1310); and
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.f.xlix (Paragraphs 1402-1403).

I incorporate that analysis by reference.

(lxix) *'906 Patent, [89-b] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

1444. I previously analyzed Bouevitch in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.f.vi (Paragraphs 1320-1322).

I incorporate that analysis by reference.

(lxx) *'906 Patent, [89-c] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

1445. I previously analyzed Bouevitch in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.f.xvi (Paragraphs 1342-1344).

- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.f.li (Paragraphs 1405-1408).

I incorporate that analysis by reference.

(lxxi) *'906 Patent, [89-d] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said fiber collimator output ports"*

1446. I previously analyzed Bouevitch in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral

channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.f.lii (Paragraphs 1409-1410).

I incorporate that analysis by reference.

(lxxii) *'906 Patent, [89-e] "a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports."*

1447. I previously analyzed Bouevitch in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.f.ix (Paragraph 1327);
- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.f.x (Paragraph 1328);
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.f.xxii (Paragraphs 1356-1358); and
- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.f.liii (Paragraphs 1411-1414).

I incorporate that analysis by reference.

(lxxiii) *'906 Patent, [90] "The servo-based optical apparatus of claim 89 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

1448. I previously analyzed Bouevitch in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.f.ix (Paragraph 1327); and

- "said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors[,]" discussed above in Section IX.1.f.liv (Paragraphs 1415-1416).

I incorporate that analysis by reference.

(lxxiv) *'906 Patent, [91] "The servo-based optical apparatus of claim 90 wherein said servo-control assembly maintains said power levels at a predetermined value"*

1449. I previously analyzed Bouevitch in view of the following limitations:

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]" discussed above in Section IX.1.f.x (Paragraph 1328); and

- "wherein said servo-control assembly maintains said power levels at a predetermined value[,]" discussed above in Section IX.1.f.lv (Paragraph 1417).

I incorporate that analysis by reference.

(lxxv) *'906 Patent, [92] "The servo-based optical apparatus of claim 89 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."*

1450. I previously analyzed Bouevitch in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device[,]"discussed above in Section IX.1.f.xiii (Paragraph 1335);

- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said

monitoring[,]" discussed above in Section IX.1.f.xlvii (Paragraphs 1397-1398); and

- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.f.lvi (Paragraphs 1418-1419)

I incorporate that analysis by reference.

(lxxvi) *'906 Patent, [96] "The servo-based optical apparatus of claim 89 wherein each channel micromirror is a silicon micromachined mirror."*

1451. I previously analyzed Bouevitch in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.f.lvii (Paragraph 1420).

I incorporate that analysis by reference.

(lxxvii) *'906 Patent, [97] "The servo-based optical apparatus of claim 89 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

1452. I previously analyzed Bouevitch in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.f.xvii (Paragraphs 1345-1347).

I incorporate that analysis by reference.

(lxxviii) *'906 Patent, [98] "The servo-based optical apparatus of claim 89 wherein said beam-focuser comprises one or more lenses."*

1453. I previously analyzed Bouevitch in view of the following limitations:

- "wherein said beam-focuser comprises an assembly of lenses[,]"discussed above in Section IX.1.f.lxi (Paragraphs 1429-1431).

I incorporate that analysis by reference.

(lxxix) *'906 Patent, [99] "The servo-based optical apparatus of claim 89, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"*

1454. I previously analyzed Bouevitch in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.f.xix (Paragraph 1351).

I incorporate that analysis by reference.

(lxxx) *'906 Patent, [100-pre] "An optical apparatus comprising:"*

1455. I previously analyzed Bouevitch in view of the following limitations:

- "An optical . . . apparatus[,]" discussed above in Section IX.1.f.ii (Paragraphs 1308-1310).

I incorporate that analysis by reference.

(lxxxi) *'906 Patent, [100-a] "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal"*

1456. I previously analyzed Bouevitch in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.f.ii (Paragraphs 1308-1310); and
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.f.xlix (Paragraphs 1402-1403).

I incorporate that analysis by reference.

1457. Under Capella's apparent interpretation, to the extent Bouevitch does not teach "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal "an array of fiber collimators providing and serving as an input port for a multi-

wavelength optical signal[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxxii) *'906 Patent, [100-b] "a plurality of output ports"*

1458. I previously analyzed Bouevitch in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.f.iii (Paragraphs 1311-1313).

I incorporate that analysis by reference.

(lxxxiii) *'906 Patent, [100-c] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

1459. I previously analyzed Bouevitch in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.f.vi (Paragraphs 1320-1322).

I incorporate that analysis by reference.

(lxxxiv) *'906 Patent, [100-d] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

1460. I previously analyzed Bouevitch in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.f.xvi (Paragraphs 1342-1344).
- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.f.li (Paragraphs 1405-1408).

I incorporate that analysis by reference.

(lxxxv) *'906 Patent, [100-e] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually and continuously controllable to reflect said spectral channels into selected ones of said output ports"*

1461. I previously analyzed Bouevitch in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.f.lii (Paragraphs 1409-1410).

I incorporate that analysis by reference.

(lxxxvi) *'906 Patent, [100-f] "a one-dimensional array of collimator-alignment mirrors, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports"*

1462. I previously analyzed Bouevitch in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device[,]"discussed above in Section IX.1.f.xiii (Paragraph 1335);

- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.f.xlvii (Paragraphs 1397-1398); and

- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.f.lvi (Paragraphs 1418-1419)

I incorporate that analysis by reference.

1463. To the extent Bouevitch does not teach "a one-dimensional array of collimator-alignment mirrors, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxxvii) *'906 Patent, [106] "The optical apparatus of claim 100, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"*

1464. I previously analyzed Bouevitch in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.f.xix (Paragraph 1351).

I incorporate that analysis by reference.

(lxxxviii) *'906 Patent, [115-pre] "An optical system comprising a wavelength-separating-routing apparatus, wherein said wavelength-separating-routing apparatus includes"*

1465. I previously analyzed Bouevitch in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]" discussed above in Section IX.1.f.xlviii (Paragraphs 1399-1401).

I incorporate that analysis by reference.

1466. To the extent the preamble is considered limiting, Bouevitch discloses to a POSITA "An optical system comprising a wavelength-separating-routing apparatus."

1467. Bouevitch discloses dispersing or separating a beam of light into sub-beams. "FIGS. 4a and 4b are schematic diagrams showing another embodiment of the modifying means 150, wherein a birefringent crystal 152 is disposed before the liquid crystal array 130. ***A beam of light having a predetermined polarization state launched from port 102 a is dispersed into sub-beams***, which are passed through the birefringent crystal 152. The sub-beams of light

passing through the birefringent crystal 152 remain unchanged with respect to polarization. ***The sub-beams of light are transmitted through the liquid crystal array 130, where they are selectively modified, and reflected back to the birefringent crystal 152 via reflective surface 142***." Bouevitch at 7:1-12 (emphasis added); *see also id.* at FIGS. 4a-4b.

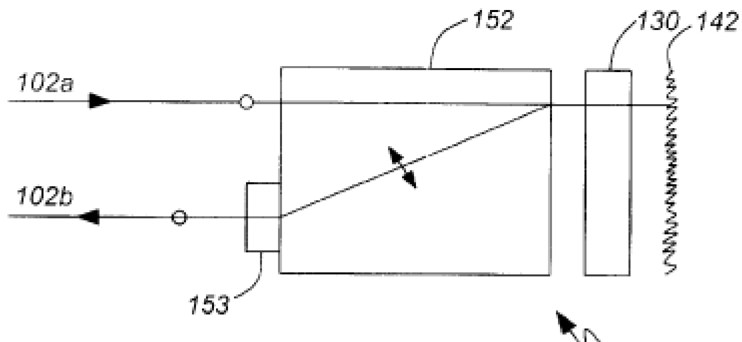


FIG. 4a

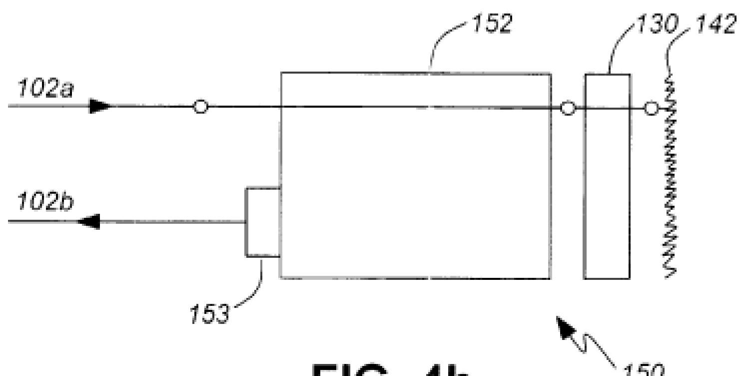


FIG. 4b

1468. Therefore, Bouevitch discloses to a POSITA "An optical system comprising a wavelength-separating-routing apparatus." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxxix) *'906 Patent, [115-a] "an array of fiber collimators, providing and serving as an input port for a multi-wavelength optical signal"*

1469. I previously analyzed Bouevitch in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.f.ii (Paragraphs 1308-1310);

- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.f.xlix (Paragraphs 1402-1403); and

- "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal[,]" discussed above in Section IX.1.f.lxxxi (Paragraphs 1455-1456).

I incorporate that analysis by reference.

(xc) *'906 Patent, [115-b] "a plurality of output ports including a pass-through port and one or more drop ports"*

1470. I previously analyzed Bouevitch in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.f.iii (Paragraphs 1311-1313); and

- "wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.f.xv (Paragraphs 1339-1341).

I incorporate that analysis by reference.

1471. Bouevitch discloses to a POSITA "said fiber collimator pass-through port receives a subset of said spectral channels."

1472. Bouevitch discloses a passthrough port receiving and propagating light. Referring to FIG. 11, reflector 51 is orientated such that the sub-beam of light corresponding to λ1 incident thereon, is reflected back along the same optical path to the lens 90, passes through port 85 again, and propagates to port 2 of circulator 80a where it is circulated to port 3. Reflector 52, however, is orientated such that the sub-beam of light corresponding to λ2 is reflected back along a different optical path. Accordingly, the dropped signal corresponding to wavelength λ2 is returned to the lens 90, passes through port 87, propagates to port 2 of the second circulator

80b, and is circulated to port 3." Bouevitch at 14:55-65; *see also id.* at 6:20-25 (that the modifying means of the ROADM allows a light beam to pass through unchanged).

1473. Therefore, Bouevitch discloses to a POSITA "said fiber collimator pass-through port receives a subset of said spectral channels." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xci) *'906 Patent, [115-c] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

1474. I previously analyzed Bouevitch in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.f.vi (Paragraphs 1320-1322).

I incorporate that analysis by reference.

(xcii) *'906 Patent, [115-d] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

1475. I previously analyzed Bouevitch in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.f.xvi (Paragraphs 1342-1344).
- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.f.li (Paragraphs 1405-1408).

I incorporate that analysis by reference.

(xciii) *'906 Patent, [115-e] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels."*

1476. I previously analyzed Bouevitch in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.f.lii (Paragraphs 1409-1410)

I incorporate that analysis by reference.

1477. Bouevitch discloses to a POSITA "said fiber collimator pass-through port receives a subset of said spectral channels."

1478. Bouevitch discloses a pass-through port receiving and propagating light. Referring to FIG. 11, reflector 51 is orientated such that the sub-beam of light corresponding to λ1 incident thereon, is reflected back along the same optical path to the lens 90, passes through port 85 again, and propagates to port 2 of circulator 80a where it is circulated to port 3. Reflector 52, however, is orientated such that the sub-beam of light corresponding to λ2 is reflected back along a different optical path. Accordingly, the dropped signal corresponding to

wavelength λ2 is returned to the lens 90, passes through port 87, propagates to port 2 of the second circulator 80b, and is circulated to port 3." Bouevitch at 14:55-65.

1479. Therefore, Bouevitch discloses to a POSITA "said fiber collimator pass-through port receives a subset of said spectral channels." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(xciv)** *'906 Patent, [116] "The optical system of claim 115 further comprising a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports"*

1480. I previously analyzed Bouevitch in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.f.ix (Paragraph 1327);
- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.f.x (Paragraph 1328);
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.f.xxii (Paragraphs 1356-1358); and
- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.f.liii (Paragraphs 1411-1414).

I incorporate that analysis by reference.

(xcv) *'906 Patent, [117] "The optical system of claim 116 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

1481. I previously analyzed Bouevitch in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.f.ix (Paragraph 1327); and
- "said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors[,]" discussed above in Section IX.1.f.liv (Paragraphs 1415-1416).

I incorporate that analysis by reference.

(xcvi) *'906 Patent, [118] "The optical system of claim 115 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimators, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports."*

1482. I previously analyzed Bouevitch in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device[,]"discussed above in Section IX.1.f.xiii (Paragraph 1335);
- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.f.xlvii (Paragraphs 1397-1398); and
- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.f.lvi (Paragraphs 1418-1419)

I incorporate that analysis by reference.

(xcvii) *'906 Patent, [122] "The optical system of claim 115 wherein each channel micromirror is a silicon micromachined mirror."*

1483. I previously analyzed Bouevitch in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.f.lvii (Paragraph 1420).

I incorporate that analysis by reference.

(xcviii) *'906 Patent, [123] "The optical system of claim 115 wherein said beam-focuser comprises a focusing lens having first and second focal points, and wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points"*

1484. I previously analyzed Bouevitch in view of the following limitations:

- "wherein said beam-focuser comprises a focusing lens having first and second focal points[,]"discussed above in Section IX.1.f.lix (Paragraphs 1422-1424); and
- "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens[,]"discussed above in Section IX.1.f.lx (Paragraphs 1425-1428).

I incorporate that analysis by reference.

(xcix) *'906 Patent, [124] "The optical system of claim 115 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

1485. I previously analyzed Bouevitch in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.f.xvii (Paragraphs 1345-1347).

I incorporate that analysis by reference.

(c) *'906 Patent, [125] "The optical system of claim 115 further comprising a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors"*

1486. I previously analyzed Bouevitch in view of the following limitations:

- "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors[,]"discussed above in Section IX.1.f.lxiii (Paragraphs 1433-1435).

I incorporate that analysis by reference.

(ci) *'906 Patent, [126-pre] "The optical system of claim 115 further comprising an auxiliary wavelength-separating-routing apparatus, including:"*

1487. To the extent Bouevitch does not teach "an auxiliary wavelength-separating-routing apparatus[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cii) *'906 Patent, [126-a] "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports"*

1488. Under Capella's apparent interpretation, to the extent Bouevitch does not teach "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

(ciii) *'906 Patent, [126-b] "an exiting port"*

1489. Bouevitch discloses to a POSITA "an exiting port."

1490. Bouevitch discloses an exiting port. "FIG. 8 illustrates a DGE including a conventional three port optical circulator and having a particularly symmetrical design. A beam

of light is launched into a first port 882 of the circulator 880 where it circulates to and exits through port 884." Bouevitch at 11:15-19.

1491. Therefore, Bouevitch discloses to a POSITA "an exiting port." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(civ) *'906 Patent, [126-c] "an auxiliary wavelength-separator"*

1492. To the extent Bouevitch does not teach "an auxiliary wavelength-separator[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cv) *'906 Patent, [126-d] "an auxiliary beam-focuser"*

1493. Bouevitch discloses to a POSITA "an auxiliary beam-focuser."

1494. Bouevitch also discloses multiple optical elements (110a, 110b in FIG. 1 below) that can focus a beam. "The optical design includes a diffraction element 120 disposed between and at a focal plane of identical elements 110a and 110b having optical power, respectively. Two ports 102a and 102b are shown at an input/output end with bi-directional arrows indicating that light launched into port 102a can be transmitted through the optical device and can be reflected backward to the input port from which it was launched 102a, or alternatively, can be switched to port 102b or vice versa in a controlled manner. The input/output ports 102a and 102b are also disposed about one focal plane away from the element having optical power 110a to which they are optically coupled. Although only two input/output ports are shown to facilitate an understanding of this device, a plurality of such pairs of ports is optionally provided. At the other end of the device, modifying means 150 for modifying at least a portion of the light incident thereon is provided about the focal plane of the element having optical power 110b." Bouevitch at 5:15-38; *see also id.* at FIG. 1.

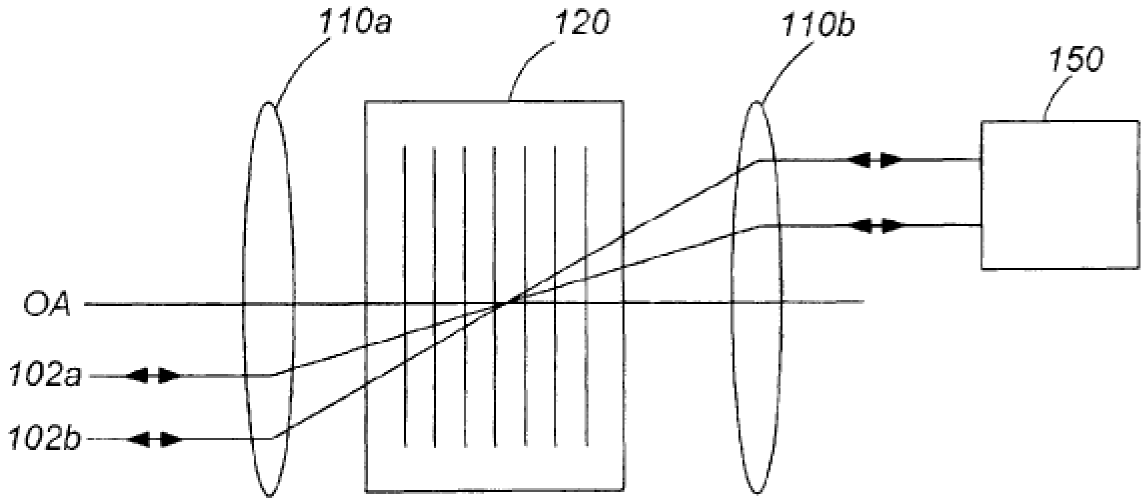


FIG. 1

1495. Therefore, Bouevitch discloses to a POSITA "an auxiliary beam-focuser." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cvi) *'906 Patent, [126-e] "a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors"*

1496. To the extent Bouevitch does not teach "a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said

auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cvii) *'906 Patent, [127] "The optical system of claim 126 wherein said auxiliary channel micromirrors are individually pivotable."*

1497. Bouevitch discloses to a POSITA "wherein said auxiliary channel micromirrors are individually pivotable."

1498. Bouevitch discloses a pivotable MEMS array. "Moreover, it is also within the scope of the instant invention for the MEMs array to flip in either a horizontal or vertical direction, relative to the dispersion plane. Furthermore, any combination of the above embodiments and/or components are possible." Bouevitch at 15:30-34; *see also id.* at 14:5-65.

1499. Therefore, Bouevitch discloses to a POSITA "wherein said auxiliary channel micromirrors are individually pivotable." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cviii) *'906 Patent, [129] "The optical system of claim 126 wherein each auxiliary channel micromirror is a silicon micromachined mirror"*

1500. To the extent Bouevitch does not teach "wherein each auxiliary channel micromirror is a silicon micromachined mirror[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(cix)** *'906 Patent, [130] "The optical system of claim 126 wherein said auxiliary wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

1501. Bouevitch discloses to a POSITA "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."

1502. Bouevitch discloses the use of diffraction elements. "The optical design includes a diffraction element 120 disposed between and at a focal plane of identical elements 110a and 110b having optical power, respectively." Bouevitch at 5:20-22. To the extent Bouevitch does not teach "ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1503. Therefore, Bouevitch discloses to a POSITA "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms." Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(cx)** *'906 Patent, [131] "The optical system of claim 126 wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports."*

1504. To the extent Bouevitch does not teach "The optical system of claim 126 wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input

ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cxi) *'906 Patent, [132] "The optical system of claim 115, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator."*

1505. I previously analyzed Bouevitch in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.f.xix (Paragraph 1351).

I incorporate that analysis by reference.

(cxii) *'906 Patent, [133] "A method of performing dynamic wavelength separating and routing, comprising"*

1506. I previously analyzed Bouevitch in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]"discussed above in Section IX.1.f.xlviii (Paragraphs 1399-1401).

I incorporate that analysis by reference.

1507. To the extent the language in the preamble is considered limiting, Bouevitch discloses a "method" of performing dynamic wavelength separating and routing.

1508. Bouevitch discloses a method of separating and routing different signals or wavelengths to different inputs. "In accordance with the instant invention there is further provided a method of rerouting and modifying an optical signal comprising the steps of: launching a beam of light towards an element having optical power off an optical axis thereof; redirecting the beam of light incident on the element having optical power to a dispersive element disposed substantially one focal length away from the element having optical power; spatially dispersing the redirected beam of light into a plurality of different sub-beams of light corresponding to a plurality of different spectral channels with a dispersive element disposed

substantially one focal length away from the element having optical power; redirecting the plurality of different sub-beams of light to a modifying means optically disposed substantially two focal lengths away from the dispersive element; selectively modifying the plurality of different sub-beams of light and reflecting them in a substantially backwards direction; and redirecting the selectively modified plurality of different sub-beams to the dispersive element and combining them to form a single output beam of light, wherein the plurality of different sub-beams of light and the selectively modified plurality of different sub-beams follow substantially parallel optical paths to and from the modifying means, respectively." Bouevitch at 3:9-31.

1509. Therefore, Bouevitch discloses to a POSITA a "method" of performing dynamic wavelength separating and routing. Even if Bouevitch does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cxiii) *'906 Patent, [133-a] "receiving a multi-wavelength optical signal from a fiber collimator input port"*

1510. I previously analyzed Bouevitch in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.f.iii (Paragraphs 1311-1313); and
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.f.xlix (Paragraphs 1402-1403).

I incorporate that analysis by reference.

(cxiv) *'906 Patent, [133-b] "separating said multi-wavelength optical signal into multiple spectral channels"*

1511. I previously analyzed Bouevitch in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.f.vi (Paragraphs 1320-1322).

I incorporate that analysis by reference.

(cxv) *'906 Patent, [133-c] "focusing said spectral channels onto a spatial array of corresponding beam-deflecting elements, whereby each beam-deflecting element receives one of said spectral channels"*

1512. I previously analyzed Bouevitch in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.f.xvi (Paragraphs 1342-1344); and

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels," discussed above in Section IX.1.f.vii (Paragraphs 1323-1325)

I incorporate that analysis by reference.

(cxvi) *'906 Patent, [133-d] "dynamically and continuously controlling said beam-deflecting elements in two dimensions to direct said spectral channels into any selected ones of output ports and to control the power of the spectral channels coupled into said selected output ports"*

1513. I previously analyzed Bouevitch in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325);

- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.f.viii (Paragraph 1326);

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.f.ix (Paragraph 1327);

- "said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal[,]" discussed above in Section IX.1.f.xiv (Paragraphs 1336-1338);

- "controlling dynamically and continuously said beam-deflecting elements in two dimensions[,]"discussed above in Section IX.1.f.xli (Paragraphs 1385-1388);

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.f.lii (Paragraphs 1409-1410)

I incorporate that analysis by reference.

(cxvii) *'906 Patent, [134] "The method of claim 133 further comprising the step of providing feedback control of said beam-deflecting elements to maintain a predetermining coupling of each spectral channel directed into one of said output ports."*

1514. I previously analyzed Bouevitch in view of the following limitations:

- "a spatial array of beam-deflecting elements[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325);

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.f.ix (Paragraph 1327);

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.f.x (Paragraph 1328);

- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.f.xxii (Paragraphs 1356-1358); and

- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.f.liii (Paragraphs 1411-1414).

I incorporate that analysis by reference.

(cxviii) *'906 Patent, [135] "The method of claim 134 further comprising the step of maintaining power levels of said spectral channels directed into said output ports at a predetermining value."*

1515. I previously analyzed Bouevitch in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.f.ix (Paragraph 1327); and
- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.f.x (Paragraph 1328).

I incorporate that analysis by reference.

(cxix) *'906 Patent, [137] "The method of claim 133 wherein a subset of said spectral channels is directed into one of said output ports, thereby providing one or more pass-through spectral channels."*

1516. I previously analyzed Bouevitch in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.f.vii (Paragraphs 1323-1325);
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and

continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.f.lii (Paragraphs 1409-1410); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels[,]"discussed above in Section IX.1.f.xciii (Paragraphs 1721-1724).

I incorporate that analysis by reference.

(cxx) *'906 Patent, [138] "The method of claim 137 further comprising the step of multiplexing said pass-through spectral channels with one or more add spectral channels, so as to provide an output optical signal."*

1517. I previously analyzed Bouevitch in view of the following limitations:

- "wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors[,]"discussed above in Section IX.1.f.cvi (Paragraph 1495).

I incorporate that analysis by reference.

(cxxi) *'906 Patent, [139] "The method of claim 133 wherein said beam-deflecting elements comprise an array of silicon micromachined mirrors."*

1518. I previously analyzed Bouevitch in view of the following limitations:

- "a spatial array of beam-deflecting elements[,]"discussed above in Section IX.1.f.vii (Paragraphs 1323-1325);

- "a spatial array of channel micromirrors[,] discussed above in Section IX.1.f.lii (Paragraphs 1409-1410); and

- "wherein each channel micromirror is a silicon micromachined mirror[,]" discussed above in Section IX.1.f.lvii (Paragraph 1420).

I incorporate that analysis by reference.

g) U.S. Patent No. 6,978,062 ("Rose")

1519. Rose is directed to an add/drop multiplexer "A wavelength division multiplexed device is based on a transmission grating spectrometer having at least two diffractive optical elements. The WDM device provides flexible use and may be widely applied in WDM systems. The device is useful for multiplexing and demultiplexing, channel monitoring, and for adding and dropping channels. The device provides programmability in use as an add/drop multiplexer." Rose at Abstract; *see also id.* at FIG. 33 (disclosing a switch array of controllable mirrors).

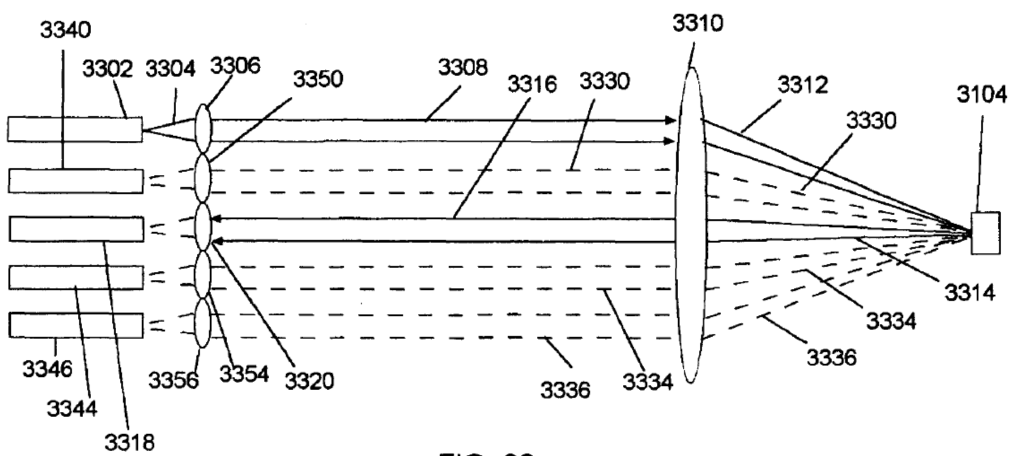


FIG. 33

(i) Rose *Is Prior Art to the Asserted Claims*

1520. Rose claims priority to Application No. 09/474,544 filed on December 29, 1999, and issued on September 23, 2003. Accordingly, Rose is prior art to the '905 and '906 Patents under at least pre-AIA 35 U.S.C. § 102(e).

1521. Accordingly, it is my understanding that Rose is prior art to the '905 and '906 Patents under at least pre-AIA 35 U.S.C. § 102(e).

(ii) *'905 Patent, [23-pre]: "An optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports, the apparatus comprising"*

1522. To the extent the language in the preamble is considered limiting, Rose discloses to a POSITA "[a]n optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports."

1523. Rose discloses an add/drop device. For example, "[an] embodiment of a transmission grating add/drop device 3100 is illustrated in FIG. 31. In this device 3100, there are several ports for light to enter or exit. The first port 3102 is an input port for inputting light to the device 3100. Light reaches the switch array 3104 from the first port 3102 along a first path 3106 (solid line) after the different channels are separated by being dispersed by the transmission gratings. The switch array 3104 is disposed so that each separated channel has a respective optical switch 3108 that selectively reflects the light of its associated channel into one of a number of different directions." Rose at 18:10-20.

1524. Rose discloses multiple output ports and output fibers. For example, "each channel may be independently switchable to a number of different output ports through selective positioning of the respective switches 3108. In the illustration, the switch 3108 is in a position to direct light along path 3112, shown in solid line, to port 3122. The other possible paths 3110, 3114 and 3116 are shown in dashed line." Rose at 18:30-41; *see also id.* at FIG. 31.

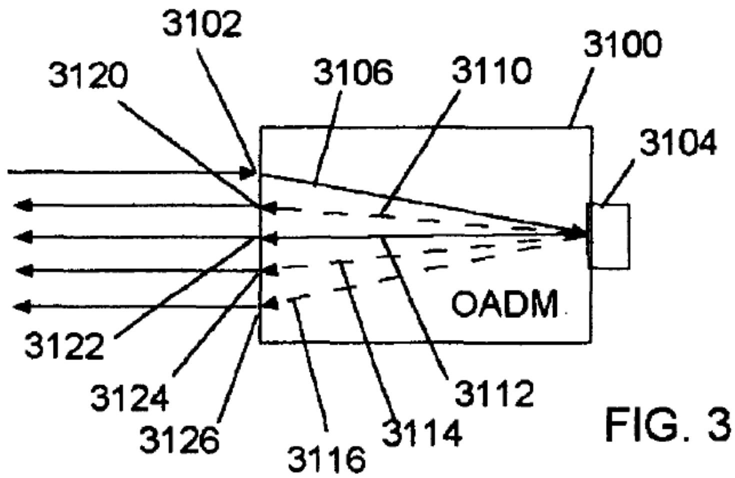


FIG. 31

1525. Rose discloses collimating light from and to fibers. “Light 3304 enters the device 3100 through a first fiber 3302 and is collimated in a first collimating unit 3306. The collimated beam 3308 passes through the transmission gratings (not shown) to the focusing optic 3310, which directs the focused beam 3312 to the switch array 3104. The switch array 3104 directs each channel along a particular selected reflected path. Only one channel is illustrated in the figure. The channel is reflected along path 3112, that corresponds to the path traveled by the diverging beam 3314, collimated by the focusing optic 3310 to produce collimated beam 3316, and collimated beam 3316 which is focused into fiber 3318 by focusing system 3320.” Rose at 18:42-55; *see also id.* at FIG. 33. Rose also discloses collimator units that focus light to and from the fibers.” Rose at 18:42-64 and FIG. 33. To the extent that “fiber collimator” port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a “fiber collimator” port in a single package.

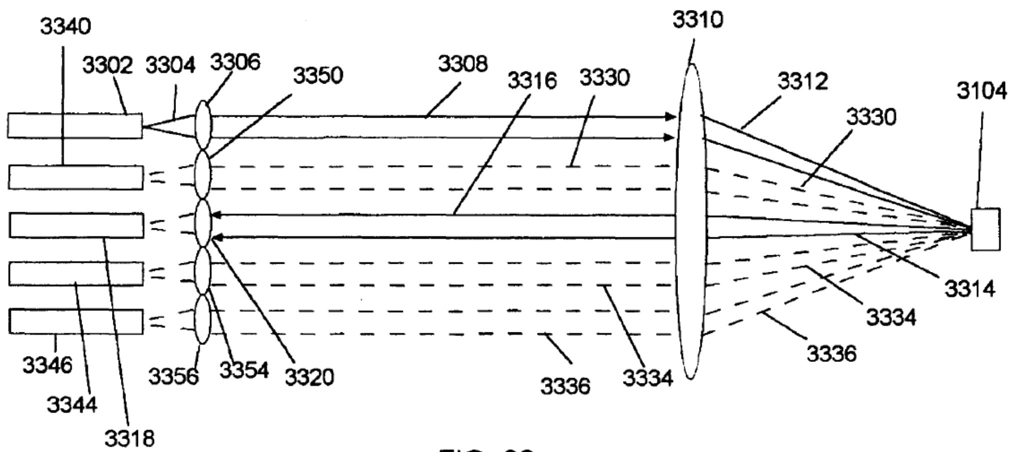


FIG. 33

1526. Therefore, under Capella's apparent interpretation, Rose discloses to a POSITA "[a]n optical add-drop apparatus comprising an output port and fiber collimators serving as an input port and one or more other ports." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(iii) *'905 Patent, [23-a] "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels"*

1527. Under Capella's apparent interpretation, Rose discloses to a POSITA "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels."

1528. Rose discloses receiving an input signal from an input fiber, and collimating the multi-wavelength signal into a collimated beam. For example, "in FIG. 31 … there are several ports for light to enter or exit. The first port 3102 is an input port for inputting light to the device 3100. Light reaches the switch array 3104 from the first port 3102 along a first path 3106 (solid line) after the different channels are separated by being dispersed by the transmission gratings. The switch array 3104 is disposed so that each separated channel has a respective

optical switch 3108 that selectively reflects the light of its associated channel into one of a number of different directions." Rose at 18:10-20; *see also id.* at FIG. 31. Additionally, Rose discloses "Light 3304 enters the device 3100 through a first fiber 3302 and is collimated in a first collimating unit 3306. The collimated beam 3308 passes through the transmission gratings (not shown) to the focusing optic 3310, which directs the focused beam 3312 to the switch array 3104. The switch array 3104 directs each channel along a particular selected reflected path. Only one channel is illustrated in the figure. The channel is reflected along path 3112, that corresponds to the path traveled by the diverging beam 3314, collimated by the focusing optic 3310 to produce collimated beam 3316, and collimated beam 3316 which is focused into fiber 3318 by focusing system 3320." Rose at 18:42-55; *see also id.* at FIG. 33. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

1529.

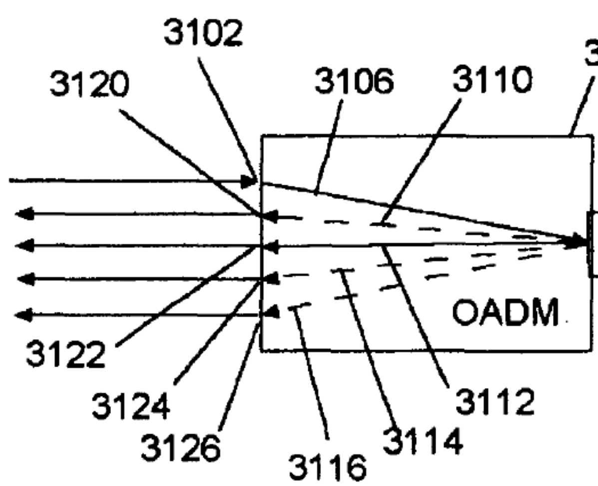


FIG. 31

1530. Therefore, under Capella's apparent interpretation, Rose discloses to a POSITA "the fiber collimator input port for an input multi-wavelength optical signal having first spectral

channels." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(iv) *'905 Patent, [23-b] "the fiber collimator one or more other ports for second spectral channels"*

1531. Under Capella's apparent interpretation, Rose discloses to a POSITA "the fiber collimator one or more other ports for second spectral channels."

1532. Rose discloses the switching array can include one or more other ports for receiving light inputting or adding light, or dropping or outputting light. "It will be appreciated that light may be directed into the device 3100 in the reverse direction, so that light entering the device 3100 from ports 3120, 3122, 3124 and 3126 is combined into an output signal that exits the device from port 3102. In such a case, the device 3100 operates as a multiple input add filter. Furthermore, light input to the device from ports 3120, 3122, 3124 and 3126 need not be directed to port 3102 but, so long as the switches 3108 provide suitable selectivity, may be directed to any of the other ports." Rose at 18:64-19:6; *see also id.* at FIG. 31. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

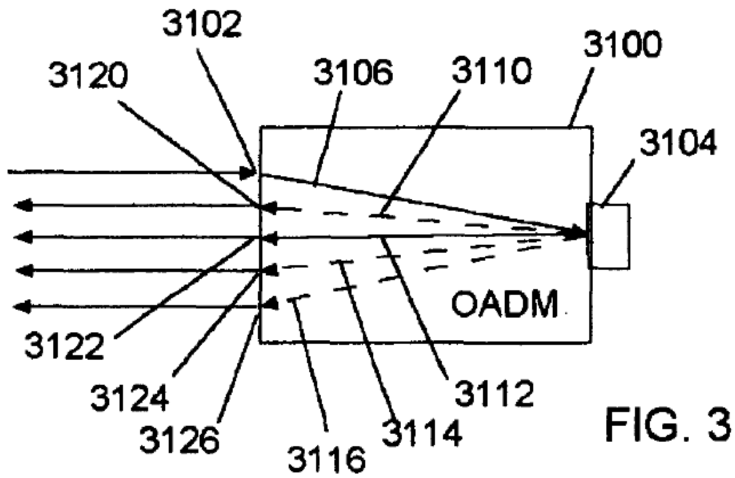


FIG. 31

1533. Therefore, under Capella's apparent interpretation, Rose discloses to a POSITA "the fiber collimator one or more other ports for second spectral channels." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(v) *'905 Patent, [23-c] "the output port for an output multi-wavelength optical signal"*

1534. Rose discloses to a POSITA "the output port for an output multi-wavelength optical signal."

1535. Rose discloses combining one or more channels into a single output signal, creating a multi-wavelength signal for the output port. "Light reflected by the switch array 2204 is directed along a second path 2210 that passes through the transmission gratings. Those channels whose light is reflected by the switch array 2204 are recombined into a single output signal appearing at the third port 2212. In the illustration, channels having wavelengths λ0-λm0 are directed into the device 2200 through the first port 2202. The switch array 2204 selects the channel having a wavelength Ai for transmission through the second port 2208, while all other channels are reflected for output from the third port 2212. Thus, unlike the embodiment

illustrated in FIG. 10, this embodiment does not require the use of a circulator to separate the input from the reflected output. It will be appreciated that the switch array 2204 may select any combination of one or more channels for transmission." 17:57-18:4. Rose further discloses that each channel may be independently switchable to a number of different output ports. A POSITA would understand that one or more channels can be transmitted to be combined into a single output signal, creating a multi-wavelength signal for the output port. "The light reflected by the switch array 3104 is directed back through the transmission gratings. The switches 3108 are selectively operable between a number of positions, four in the illustrated embodiment, that correspond to different paths 3110, 3112, 3114 and 3116 coupled to respective selected channel ports 3120, 3122, 3124 and 3126. Thus, each channel may be independently switchable to a number of different output ports through selective positioning of the respective switches 3108. In the illustration, the switch 3108 is in a position to direct light along path 3112, shown in solid line, to port 3122. The other possible paths 3110, 3114 and 3116 are shown in dashed line." Rose at 18:30-41; *see also id.* at FIG. 31.

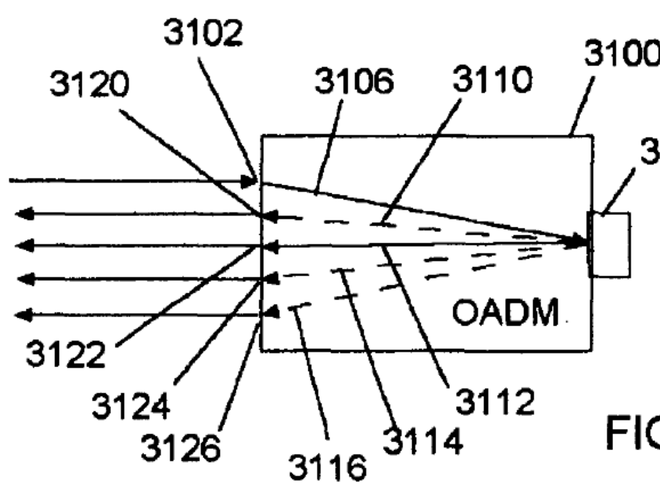


FIG. 31

1536. Therefore, Rose discloses to a POSITA "the output port for an output multi-wavelength optical signal." Even if Rose does not do so, however, these limitations would have

been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(vi) *'905 Patent, [23-d] "a wavelength-selective device for spatially separating said spectral channels"*

1537. Rose discloses to a POSITA "a wavelength-selective device for spatially separating said spectral channels."

1538. Rose discloses separating the light using transmission gratings to spatially separate the spatial channels from the input optical signal. "Another embodiment of a transmission grating add/drop device 3100 is illustrated in FIG. 31. In this device 3100, there are several ports for light to enter or exit. The first port 3102 is an input port for inputting light to the device 3100. Light reaches the switch array 3104 from the first port 3102 along a first path 3106 (solid line) after the different channels are separated by being dispersed by the transmission gratings. The switch array 3104 is disposed so that each separated channel has a respective optical switch 3108 that selectively reflects the light of its associated channel into one of a number of different directions." Rose at 18:10-20; *see also id.* at FIG. 31.

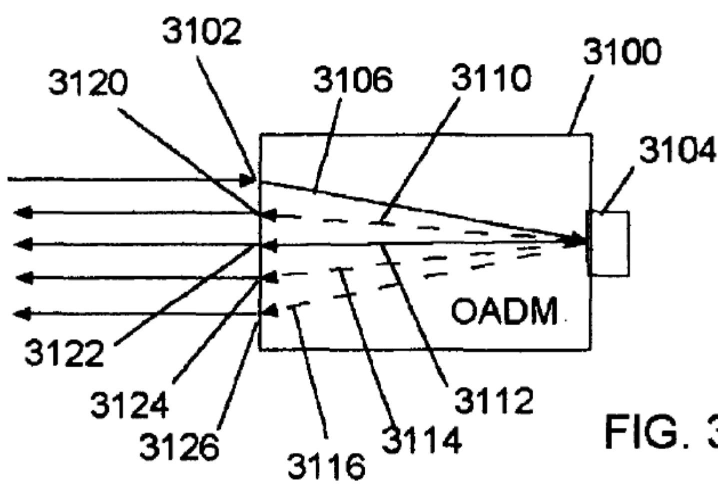


FIG. 31

Therefore, Rose discloses to a POSITA "a wavelength-selective device for spatially separating said spectral channels." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(vii) *'905 Patent, [23-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port"*

1539. Rose discloses to a POSITA "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels."

1540. Rose discloses to a POSITA "each of said elements being … controllable … to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports."

1541. Rose discloses to a POSITA "each of said elements being … controllable … to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports."

1542. Rose discloses to a POSITA "each of said elements being individually … controllable … to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports."

1543. Rose discloses "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually … controllable ... to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral

channel reflected to said output port or the fiber collimator selected port." To the extent Rose does not teach "continuously controllable in two dimensions[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1544. Rose discloses to a POSITA "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually … controllable … to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port."

1545. Rose discloses an optical add/drop multiplexer that includes a switch array to receive the separated spectral channels. For example, "[an] embodiment of a transmission grating add/drop device 3100 is illustrated in FIG. 31. In this device 3100, there are several ports for light to enter or exit. The first port 3102 is an input port for inputting light to the device 3100. Light reaches the switch array 3104 from the first port 3102 along a first path 3106 (solid line) after the different channels are separated by being dispersed by the transmission gratings. The switch array 3104 is disposed so that each separated channel has a respective optical switch 3108 that selectively reflects the light of its associated channel into one of a number of different directions." Rose at 18:10-20.

1546. Rose discloses each switch can independently receive a separated spectral channel. For example, "each channel may be independently switchable to a number of different output ports through selective positioning of the respective switches 3108. In the illustration, the switch 3108 is in a position to direct light along path 3112, shown in solid line, to port 3122.

The other possible paths 3110, 3114 and 3116 are shown in dashed line." Rose at 18:30-41; *see also id.* at FIG. 31.

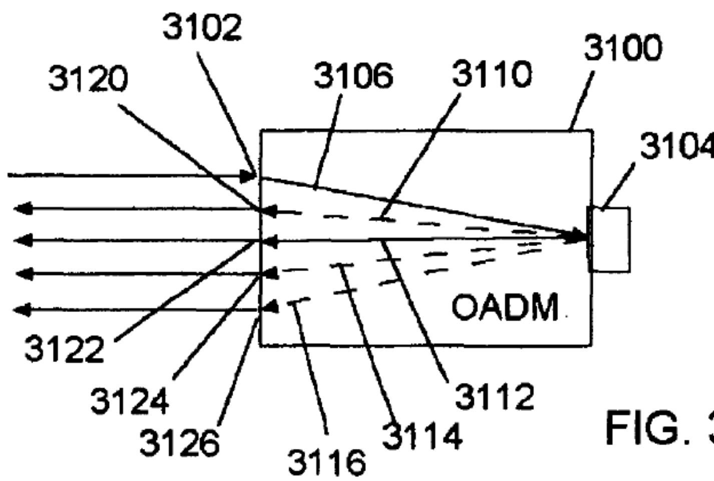


FIG. 31

1547. Rose discloses the switches and the reflectors can be as a MEMS device having micromachined deformable mirrors. "An embodiment of a reflective switch 1516 that may be used in the embodiment of OADM of in FIGS. 15 and 16 is illustrated in FIGS. 17 A and 17B. The switch 1516 may be a MEMs device having a reflecting surface 1518 that can be moved between at least two positions. The switch may be, for example, a linear MMDM (micromachined deformable mirror) supplied by Flexible Optics BV, Netherlands." Rose at 14:55-61. A POSITA would understand the reflectors could be silicon MEMS micromachined mirrors since these types of devices were known in the art and commercially available.

1548. Rose discloses that a reflector of the switch can receive the optical signal and reflect the signal to an output port. "An embodiment of a switch having multiple states is illustrated in FIG. 32. The switch 3108 has a reflector 3202 that is selectively movable among several different positions. In the particular embodiment illustrated, the reflector 3202 is pivotable among four different positions: one position is illustrated as a solid line, and the other positions 3206 are illustrated with dashed lines. It will be appreciated that the switch may be

selectively adjustable between a number of positions that is different from four." Rose at 18:21-29; *see also id.* at FIG. 32.

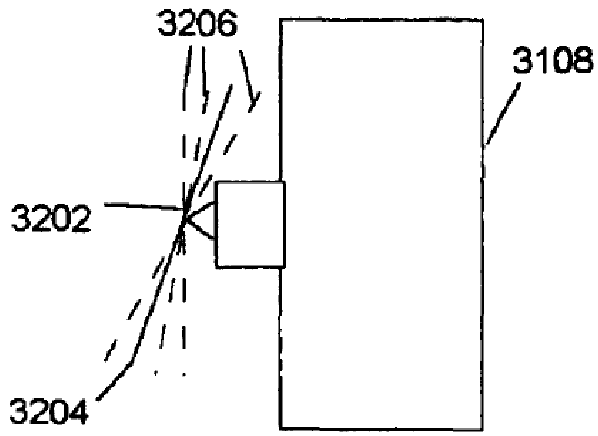


FIG. 32

1549. Rose also discloses that each switch is independently and selectively movable to provide selective switching of different channels into different outputs. "An embodiment of a switch having multiple states is illustrated in FIG. 32. The switch 3108 has a reflector 3202 that is selectively movable among several different positions. In the particular embodiment illustrated, the reflector 3202 is pivotable among four different positions: one position is illustrated as a solid line, and the other positions 3206 are illustrated with dashed lines. It will be appreciated that the switch may be selectively adjustable between a number of positions that is different from four." Rose at 18:21-29; *see also id.* at FIGS. 31-33.

1550. Rose discloses monitoring the power levels of individual channels to control the power of the spectral channels. "One particular application for a channel monitor 700 is illustrated in FIG. 7. A fiber 702 includes a fiber amplifier 704, such as an erbium-doped fiber amplifier or a Raman fiber amplifier. Pump light is generated by one or more pump lasers 706 and is coupled into the fiber 702 via a coupler 708. A portion of the amplified signal is coupled

out of the fiber 702 by the coupler 710 and directed to the channel monitor 700. The channel monitor 700 detects the power levels of the individual channels propagating along the fiber. The process of amplification in the amplifier 704 may favor some channels over others, with the result that the favored channels have power levels greater than the power levels of other channels. It is often preferred that the power levels of the different channels be uniform, in order to keep the power spread among the channels within the receivers' dynamic range." Rose at 11:60-12:8.

1551. Therefore, Rose discloses to a POSITA "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually … controllable ... to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Rose does not teach "continuously controllable in two dimensions[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. For example, it would have been within the common knowledge of a POSITA to use a "control unit 810 [that] is coupled to the switch unit 804 to control the activation states of the switch 806, thus providing programmability to the OADM device" (Rose at 12:31-33) to provide continuous control in two dimensions.

(viii) *'905 Patent, [24] "The optical add-drop apparatus of claim 23 further comprising a control unit for controlling each of said beam-deflecting elements"*

1552. Rose discloses to a POSITA "a control unit for controlling each of said beam-deflecting elements."

1553. Rose discloses to a POSITA "a control unit for controlling each of said beam-deflecting elements." For example, "[a] control unit 810 is coupled to the switch unit 804 to control the activation states of the switches 806, thus providing programmability to the OADM device 800." Rose at 12:31-33; *see also id.* at 18:35-19:6 (discussing the switch array directing each channel along a particular selected path).

1554. Therefore, Rose discloses to a POSITA "a control unit for controlling each of said beam-deflecting elements." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(ix) *'905 Patent, [25] "The optical add-drop apparatus of claim 24, wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements"*

1555. Rose discloses to a POSITA "a processing unit responsive to said power levels for controlling said beam-deflecting elements."

1556. Rose discloses to a POSITA "wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements."

1557. Rose discloses monitoring the power levels using a channel monitor. "One particular application for a channel monitor 700 is illustrated in FIG. 7. A fiber 702 includes a fiber amplifier 704, such as an erbium-doped fiber amplifier or a Raman fiber amplifier. Pump light is generated by one or more pump lasers 706 and is coupled into the fiber 702 via a coupler 708. A portion of the amplified signal is coupled out of the fiber 702 by the coupler 710 and directed to the channel monitor 700. The channel monitor 700 detects the power levels of the individual channels propagating along the fiber. The process of amplification in the amplifier 704 may favor some channels over others, with the result that the favored channels have power levels greater than the power levels of other channels. It is often preferred that the power levels of the different channels be uniform, in order to keep the power spread among the channels within the receivers' dynamic range." Rose at 11:60-12:8. Rose also discloses a control unit to control the switching elements. *See* Rose at 18:35-19:6. A POSITA would understand how to feed the monitor signal to a control unit to control the switching elements. "The channel monitor 700 feeds a monitor signal to the analyzer/control unit 712, which analyzes the monitor signal." Rose at 12:9-11.

1558. Therefore, Rose discloses to a POSITA "wherein the control unit further comprises a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(x) *'905 Patent, [26] "The optical add-drop apparatus of claim 25, wherein said servo-control assembly maintains said power levels at predetermined values"*

1559. Rose discloses to a POSITA "wherein said servo-control assembly maintains said power levels at predetermined values."

1560. Rose discloses monitoring the power levels using a channel monitor to keep the power spread among a predetermined range of the receiver. "One particular application for a channel monitor 700 is illustrated in FIG. 7. A fiber 702 includes a fiber amplifier 704, such as an erbium-doped fiber amplifier or a Raman fiber amplifier. Pump light is generated by one or more pump lasers 706 and is coupled into the fiber 702 via a coupler 708. A portion of the amplified signal is coupled out of the fiber 702 by the coupler 710 and directed to the channel monitor 700. The channel monitor 700 detects the power levels of the individual channels propagating along the fiber. The process of amplification in the amplifier 704 may favor some channels over others, with the result that the favored channels have power levels greater than the power levels of other channels. It is often preferred that the power levels of the different channels be uniform, in order to keep the power spread among the channels within the receivers' dynamic range." Rose at 11:60-12:8.

1561. Therefore, Rose discloses to a POSITA "wherein said servo-control assembly maintains said power levels at predetermined values." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xi) *'905 Patent, [27] "The optical add-drop apparatus of claim 24, wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal"*

1562. Rose discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal."

1563. Rose discloses a multiple output drop filter. "The switch 3108 is selectable among other paths, 3110, 3114 and 3116 that correspond to light beams 3330, 3334 and 3336, illustrated in dashed lines, that are directed to respective fibers 3340, 3344 and 3346 by respective focusing systems 3350, 3354 and 3356. Thus, the device 3100 permits selective switching of different channels into different outputs, and may be regarded as being a multiple output drop filter." Rose at 18:56-63; *see also id.* at FIG. 33.

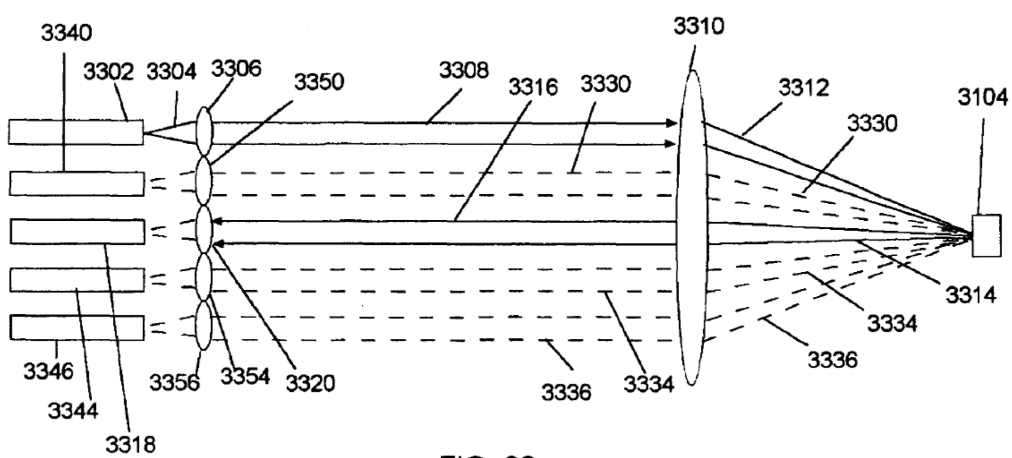


FIG. 33

1564. Therefore, Rose discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output

multi-wavelength optical signal." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xii) *'905 Patent, [28] "The optical add-drop apparatus of claim 24, wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal"*

1565. Rose discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal."

1566. Rose discloses adding a channel to a multi-wavelength signal. "Generally, the present invention relates to a WDM device that is based on the use of at least two transmissive diffraction elements. The WDM device provides flexible use and may be widely applied in WDM systems. The device is useful for multiplexing and demultiplexing, channel monitoring, and for adding and dropping channels. The device provides programmability in use as an add/drop multiplexer." Rose at 1:60-68; *see also id.* at 18:64-9:6 ("It will be appreciated that light may be directed into the device 3100 in the reverse direction, so that light entering the device 3100 from ports 3120, 3122, 3124 and 3126 is combined into an output signal that exits the device from port 3102. In such a case, the device 3100 operates as a multiple input add filter. Furthermore, light input to the device from ports 3120, 3122, 3124 and 3126 need not be directed to port 3102 but, so long as the switches 3108 provide suitable selectivity, may be directed to any of the other ports."); *see also id.* at FIG. 33.

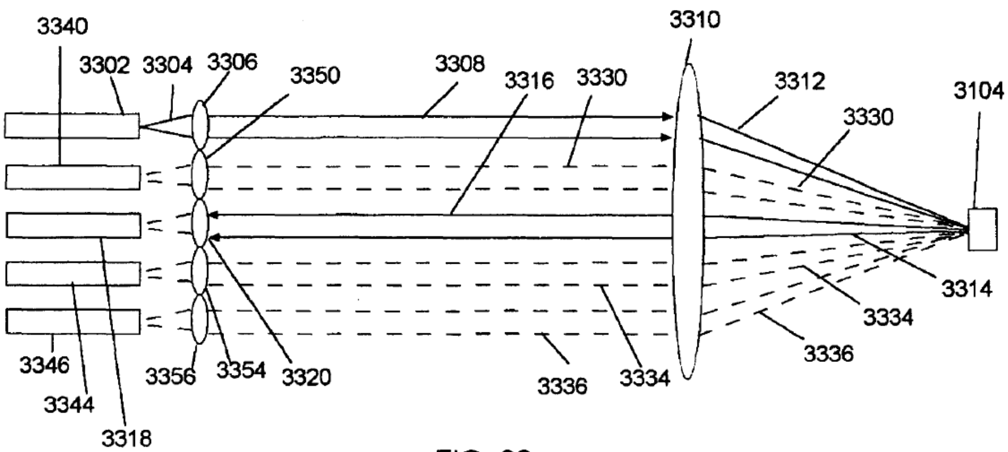


FIG. 33

1567. Therefore, Rose discloses to a POSITA "wherein the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(xiii)** *'905 Patent, [29] "The optical add-drop apparatus of claim 23 further comprising alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device"*

1568. Rose discloses to a POSITA "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device."

1569. To the extent Rose does not teach "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. For example, because mirrors are mentioned throughout the specification, it would be

within the common knowledge of a POSITA to use mirrors to align the input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device.

> **(xiv)** *'905 Patent, [31] "The optical add-drop apparatus of claim 23, wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal"*

1570. Rose discloses to a POSITA "wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal."

1571. Rose discloses combining multiple channels into a polychromatic light beam. "By proper choice of incident light angle according to equation (1), several monochromatic light beams, for example different optical channels, may be combined into a 10 polychromatic light beam using the transmission grating. In such an operation, the incident angles, α1 , α2 , . . . , are selected so that β is approximately the same for each channel. Rose at 9:9-14; *see also id.* at 18:31-41 ("The light reflected by the switch array 3104 is directed back through the transmission gratings. The switches 3108 are selectively operable between a number of positions, four in the illustrated embodiment, that correspond to different paths 3110, 3112, 3114 and 3116 coupled to respective selected channel ports 3120, 3122, 3124 and 3126. Thus, each channel may be independently switchable to a number of different output ports through selective positioning of the respective switches 3108. In the illustration, the switch 3108 is in a position to direct light along path 3112, shown in solid line, to port 3122. The other possible paths 3110, 3114 and 3116 are shown in dashed line.").

1572. Therefore, Rose discloses to a POSITA "wherein said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-

deflecting elements to form said output multi-wavelength optical signal." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xv) *'905 Patent, [32] "The optical add-drop apparatus of claim 23, wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels"*

1573. Under Capella's apparent interpretation, Rose discloses to a POSITA "wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels."

1574. Rose discloses one or more ports used to add or drop a channel. "The present invention is directed to a device for use with multiple channel optical communications, and more particularly to a device that is useful for multiplexing/demultiplexing, channel monitoring and add/drop filtering." Rose at 1:5-10; *see also id.* at 18:5-20. Each channel can be collimated by a focusing optic (reference number 3310). *See* Rose at 18:42-55; *see also id.* at FIG. 33. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

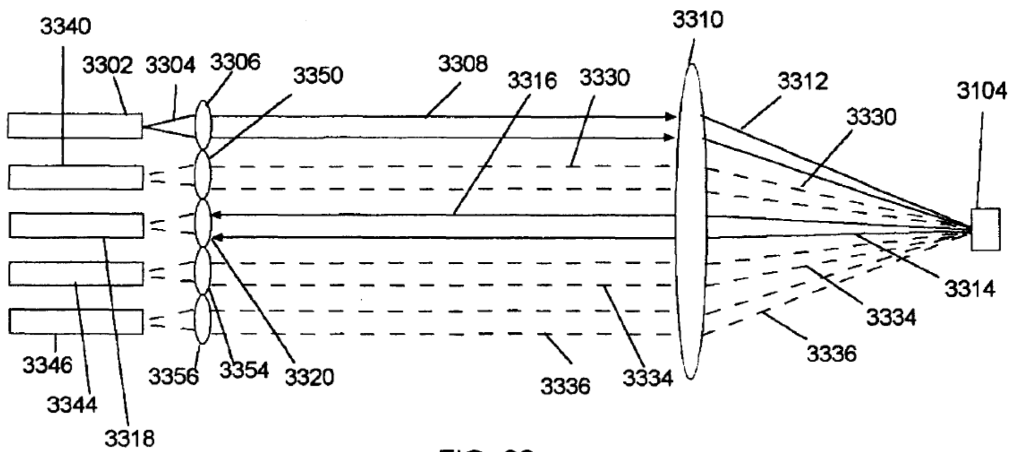


FIG. 33

1575. Therefore, under Capella's apparent interpretation, Rose discloses to a POSITA "wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xvi) *'905 Patent, [33] "The optical add-drop apparatus of claim 23 further comprising a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements"*

1576. Rose discloses to a POSITA "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements."

1577. Rose discloses a focusing optic that directs focused beams onto a reflector (reference number 3202) of the switch array. For example, "Light 3304 enters the device 3100 through a first fiber 3302 and is collimated in a first collimating unit 3306. The collimated beam 3308 passes through the transmission gratings (not shown) to the focusing optic 3310, which directs the focused beam 3312 to the switch array 3104. The switch array 3104 directs each channel along a particular selected reflected path. Only one channel is illustrated in the figure.

The channel is reflected along path 3112, that corresponds to the path traveled by the diverging beam 3314, collimated by the focusing optic 3310 to produce collimated beam 3316, and collimated beam 3316 which is focused into fiber 3318 by focusing system 3320." Rose at 18:42-49; *see also id.* at FIGS. 31-33.

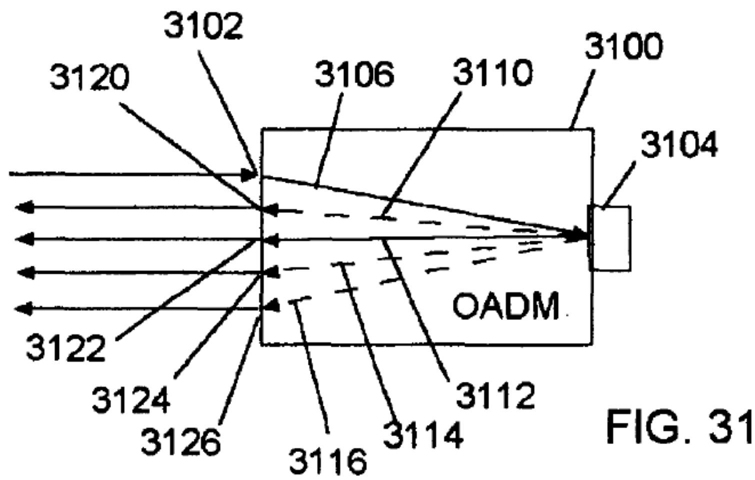


FIG. 31

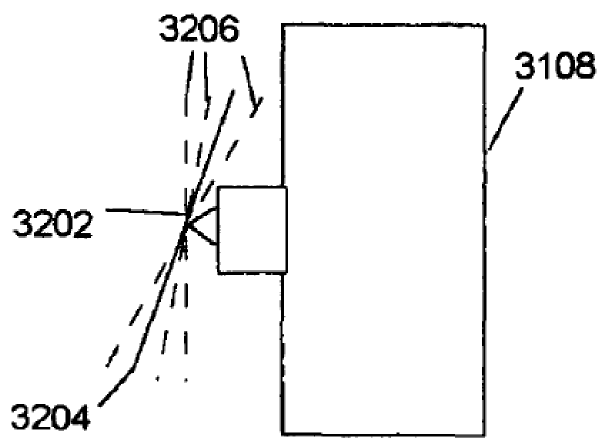


FIG. 32

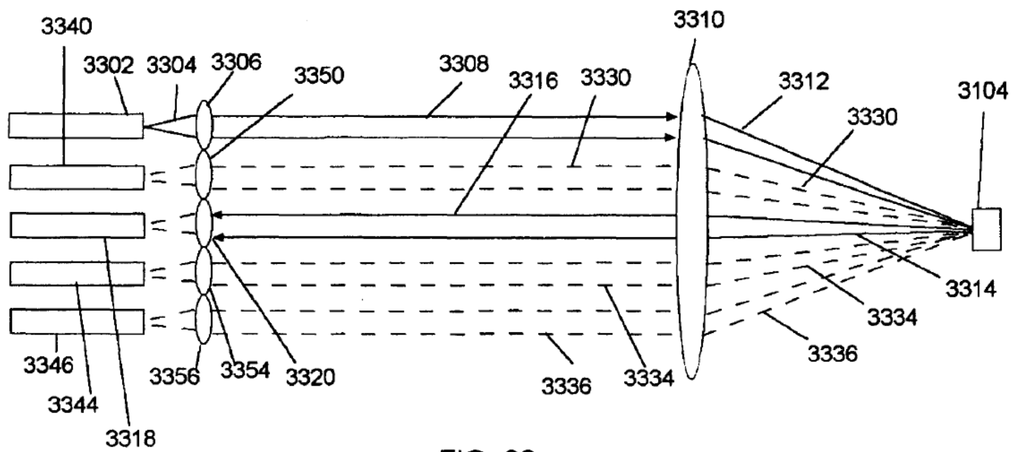


FIG. 33

1578. Therefore, Rose discloses to a POSITA "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(xvii)** *'905 Patent, [34] "The optical add-drop apparatus of claim 23, wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms"*

1579. Rose discloses to a POSITA "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."

1580. Rose discloses light being diffracted from a grating surface. *See* Rose 8:52-10:13 ("Light incident on the transmission grating at an angle, a, from an axis perpendicular to the non-grated surface, in other words perpendicular to a normal to the grating, is typically diffracted from the grating surface according to the diffraction equation … the structural parameters of the grating may be selected so that the diffraction efficiency for the TE and TM polarization states of the incident light is within no more that 10% or 5%. Other examples of

transmission diffraction gratings are described in U.S. patent application Ser. No. 09/789,888, entitled "Grating structures and Methods of Making the Grating Structures", filed on Feb. 21, 2001 and naming J. Holm, H. Madsen, S. Weichel, P. E. Isben and B. Rose as inventors, and incorporated herein by reference …").

1581. Therefore, Rose discloses to a POSITA "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xviii) *'905 Patent, [35] "The optical add-drop apparatus of claim 23, wherein said beam-deflecting elements comprise micromachined mirrors"*

1582. Rose discloses to a POSITA "wherein said beam-deflecting elements comprise micromachined mirrors."

1583. Rose discloses the switches comprising micromachined mirrors. For example, "[a]n embodiment of a reflective switch 1516 that may be used in the embodiment of OADM of in FIGS. 15 and 16 is illustrated in FIGS. 17 A and 17B. The switch 1516 may be a MEMs device having a reflecting surface 1518 that can be moved between at least two positions. The switch may be, for example, a linear MMDM (micromachined deformable mirror) supplied by Flexible Optics BV, Netherlands." Rose at 14:55-61.

1584. Therefore, Rose discloses to a POSITA "wherein said beam-deflecting elements comprise micromachined mirrors." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xix) *'905 Patent, [37] "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator"*

1585. Rose discloses to a POSITA "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator."

1586. Rose discloses it does not require the user of a circulator. ""Light reflected by the switch array 2204 is directed along a second path 2210 that passes through the transmission gratings. Those channels whose light is reflected by the switch array 2204 are recombined into a single output signal appearing at the third port 2212. In the illustration, channels having wavelengths λ0-λm0 are directed into the device 2200 through the first port 2202. The switch array 2204 selects the channel having a wavelength Ai for transmission through the second port 2208, while all other channels are reflected for output from the third port 2212. Thus, unlike the embodiment illustrated in FIG. 10, this embodiment does not require the use of a circulator to separate the input from the reflected output. It will be appreciated that the switch array 2204 may select any combination of one or more channels for transmission." Rose at 17:57-18:4.

1587. Therefore, Rose discloses to a POSITA "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xx) *'905 Patent, [39] "The optical add-drop apparatus of claim 23, wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array"*

1588. Under Capella's apparent interpretation, Rose discloses to a POSITA "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array."

1589. As shown in Figures 31 and 33, Rose illustrates that the fiber collimator ports a rearranged in a one dimensional array. *See* Rose at FIGS. 31-33.

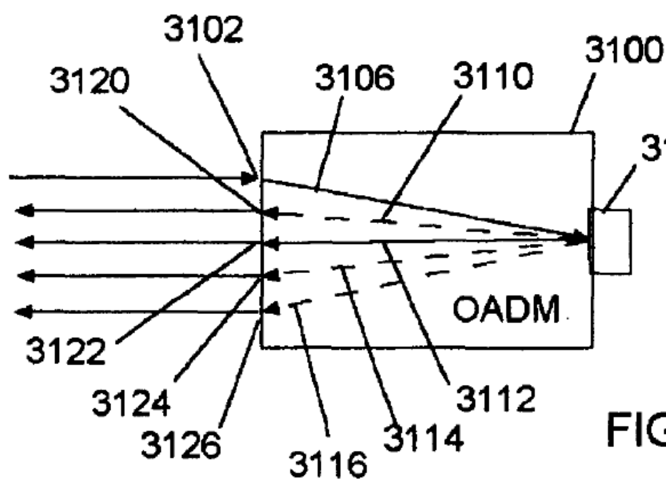


FIG. 31

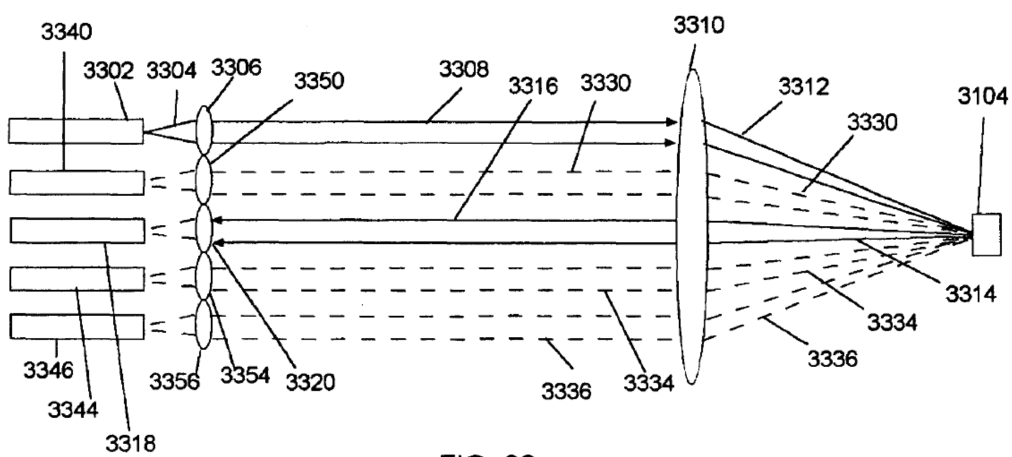


FIG. 33

1590. Therefore, under Capella's apparent interpretation, Rose discloses to a POSITA "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxi) *'905 Patent, [44] "The optical add-drop apparatus of claim 23, further comprising a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels"*

1591. Rose discloses to a POSITA "a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels."

1592. Rose discloses monitoring power levels in each channel and equalizing the power. "The device 600 may be used as a channel monitor for monitoring the power levels in each channel. This is useful for monitoring gain equalization in fiber amplifiers, fault detection in optical add/drop multiplexers (OADMs), and power equalization near transmitters and/or OADMS." Rose at 11:37-41; *see also id.* at 12:9-20 (discussing adjusting the power profile over multiple channels), 11:60-12:11 (discussing keeping the power spread among the channels within a receivers' predetermined dynamic range).

1593. Therefore, Rose discloses to a POSITA "a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxii) *'905 Patent, [45] "The optical add-drop apparatus of claim 44, wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port"*

1594. Rose discloses to a POSITA "wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port."

1595. Rose discloses that it is preferable to keep the power levels of the different channels to be uniform to keep the power spread among the channels within the receivers' dynamic range. "The device 600 may be used as a channel monitor for monitoring the power levels in each channel. This is useful for monitoring gain equalization in fiber amplifiers, fault detection in optical add/drop multiplexers (OADMs), and power equalization near transmitters and/or OADMS." Rose at 11:37-41; *see also id.* at 12:9-20 (discussing adjusting the power profile over multiple channels), 11:60-12:11 (discussing keeping the power spread among the channels within a receivers' predetermined dynamic range).

1596. Therefore, Rose discloses to a POSITA "wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxiii) *'905 Patent, [46] "The optical add-drop apparatus of claim 23, wherein the beam-deflecting elements are micromirrors"*

1597. Rose discloses to a POSITA "wherein the beam-deflecting elements are micromirrors."

1598. Rose discloses the switches comprising micromachined mirrors. For example, "[a]n embodiment of a reflective switch 1516 that may be used in the embodiment of OADM of

in FIGS. 15 and 16 is illustrated in FIGS. 17 A and 17B. The switch 1516 may be a MEMs device having a reflecting surface 1518 that can be moved between at least two positions. The switch may be, for example, a linear MMDM (micromachined deformable mirror) supplied by Flexible Optics BV, Netherlands." Rose at 14:55-61.

1599. Therefore, Rose discloses to a POSITA "wherein the beam-deflecting elements are micromirrors." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxiv) *'905 Patent, [47-pre] "An optical add-drop apparatus, comprising"*

1600. I previously analyzed Rose in view of the following limitations:

- "[a]n optical add-drop apparatus," discussed above in Section IX.1.g.ii (Paragraphs 1521-1525).

I incorporate that analysis by reference.

(xxv) *'905 Patent, [47-a] "a fiber collimator serving as an input port for an input multi-wavelength optical signal having multiple spectral channels"*

1601. I previously analyzed Rose in view of the following limitations:

- "fiber collimators serving as an input port . . . ," discussed above in Section IX.1.g.ii (Paragraphs 1521-1525); and
- "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels[,]" discussed above in Section IX.1.g.iii (Paragraphs 1526-1529).

I incorporate that analysis by reference.

(xxvi) *'905 Patent, [47-b] "an output port for an output multi-wavelength optical signal"*

1602. I previously analyzed Rose in view of the following limitations:

- "an output port . . . ," discussed above in Section IX.1.g.ii (Paragraphs 1521-1525); and

- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.g.v (Paragraphs 1533-1535).

I incorporate that analysis by reference.

(xxvii) *'905 Patent, [47-c] "one or more fiber collimators serving as one or more drop ports for selected spectral channels dropped from said multi-wavelength optical signal"*

1603. I previously analyzed Rose in view of the following limitations:

- "fiber collimators serving as . . . one or more other ports . . . ," discussed above in Section IX.1.g.ii (Paragraphs 1521-1525);

- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.g.xi (Paragraphs 1561-1563);

- "wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.g.xv (Paragraphs 1572-1574).

I incorporate that analysis by reference.

(xxviii) *'905 Patent, [47-d] "a wavelength-selective device for spatially separating said multiple spectral channels"*

1604. I previously analyzed Rose in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.g.vi (Paragraphs 1536-1537).

I incorporate that analysis by reference.

(xxix) *'905 Patent, [47-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports and to control the power of the spectral channel reflected to said output port of the fiber collimator serving as said selected port, whereby a subset of said spectral channels is directed to said fiber collimator serving as said drop ports"*

1605. I previously analyzed Rose in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550);

- "direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.g.xi (Paragraphs 1561-1563); and

- "wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.g.xv (Paragraphs 1572-1574).

I incorporate that analysis by reference.

(xxx) *'905 Patent, [48] "The optical add-drop apparatus of claim 47, wherein none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"*

1606. I previously analyzed Rose in view of the following limitations:

- "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]" discussed above in Section IX.1.g.xix (Paragraphs 1584-1586).

I incorporate that analysis by reference.

(xxxi) *'905 Patent, [49] "An optical add-drop apparatus, comprising"*

1607. I previously analyzed Rose in view of the following limitations:

- "[a]n optical add-drop apparatus[,]" discussed above in Section IX.1.g.ii (Paragraphs 1521-1525).

I incorporate that analysis by reference.

(xxxii) *'905 Patent, [49-a] "a fiber collimator serving as an input port for an input multi-wavelength optical signal having multiple spectral channels"*

1608. I previously analyzed Rose in view of the following limitations:

- "fiber collimators serving as an input port . . . [,]" discussed above in Section IX.1.g.ii (Paragraphs 1521-1525); and
- "the fiber collimator input port for an input multi-wavelength optical signal having first spectral channels[,]" discussed above in Section IX.1.g.iii (Paragraphs 1526-1529).

I incorporate that analysis by reference.

(xxxiii) *'905 Patent, [49-b] "an output port for an output multi-wavelength optical signal"*

1609. I previously analyzed Rose in view of the following limitations:

- "an output port . . . ," discussed above in Section IX.1.g.ii (Paragraphs 1521-1525); and
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.g.v (Paragraphs 1533-1535).

I incorporate that analysis by reference.

(xxxiv) *'905 Patent, [49-c] "one or more fiber collimators serving as one or more add ports for selected spectral channels to be added to said output multi-wavelength optical signal"*

1610. I previously analyzed Rose in view of the following limitations:

- "fiber collimators serving as . . . one or more other ports . . . ," discussed above in Section IX.1.g.ii (Paragraphs 1521-1525);

- "direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.g.xii (Paragraphs 1564-1566); and
- "wherein said fiber collimator one or more other ports comprise a fiber collimator add port . . for respectively adding second . . . spectral channels[,]" discussed above in Section IX.1.g.xv (Paragraphs 1572-1574).

I incorporate that analysis by reference.

(xxxv) *'905 Patent, [49-d] "a wavelength-selective device for reflecting said multiple and said selected spectral channels"*

1611. I previously analyzed Rose in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.g.vi (Paragraphs 1536-1537).

I incorporate that analysis by reference.

1612. Rose discloses to a POSITA "a wavelength-selective device for reflecting said multiple and said selected spectral channels."

1613. Rose discloses a reflector (reference number 3202) that is selectively moveable among several different positions to reflect the multiple spectral channels. "An embodiment of a switch having multiple states is illustrated in FIG. 32. The switch 3108 has a reflector 3202 that is selectively movable among several different positions. In the particular embodiment illustrated, the reflector 3202 is pivotable among four different positions: one position is illustrated as a solid line, and the other positions 3206 are illustrated with dashed lines. It will be appreciated that the switch may be selectively adjustable between a number of positions that is different from four." Rose at 18:21-29.

1614. Therefore, Rose discloses to a POSITA "a wavelength-selective device for reflecting said multiple and said selected spectral channels." Even if Rose does not do so,

however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxxvi) *'905 Patent, [49-e] "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports and to control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port, whereby said spectral channels from said fiber collimators serving as said add ports are selectively provided to said output port"*

1615. I previously analyzed Rose in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550);

- "direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.g.xii (Paragraphs 1564-1566); and

- "wherein said fiber collimator one or more other ports comprise a fiber collimator add port . . for respectively adding second . . . spectral channels[,]" discussed above in Section IX.1.g.xv (Paragraphs 1572-1574).

I incorporate that analysis by reference.

(xxxvii) *'905 Patent, [50] "The optical add-drop apparatus of claim 49, wherein none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"*

1616. I previously analyzed Rose in view of the following limitations:

- "The optical add-drop apparatus of claim 23: wherein none of the multi-wavelength optical signal, the second spectral channels, or the output

multi-wavelength optical signal are transmitted through a circulator[,]" discussed above in Section IX.1.g.xix (Paragraphs 1584-1586).

I incorporate that analysis by reference.

(xxxviii) *'905 Patent, [51-pre] "A method of performing dynamic add and drop in a WDM optical network, comprising"*

1617. I previously analyzed Rose in view of the following limitations:

- "[a]n optical add-drop apparatus[,]" discussed above in Section IX.1.g.ii (Paragraphs 1521-1525);
- "wherein the control unit controls said beam-deflecting elements to direct selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.g.xi (Paragraphs 1561-1563); and
- "the control unit controls said beam-deflecting elements to direct selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.g.xii (Paragraphs 1564-1566).

I incorporate that analysis by reference.

1618. To the extent the language in the preamble is considered limiting, Rose discloses to a POSITA "[a] method of performing dynamic add and drop in a WDM optical network."

1619. Rose discloses a method that uses a programmable WDM device to add and drop channels. "Generally, the present invention relates to a WDM device that is based on the use of at least two transmissive diffraction elements. The WDM device provides flexible use and may be widely applied in WDM systems. The device is useful for multiplexing and demultiplexing, channel monitoring, and for adding and dropping channels. The device provides programmability in use as an add/drop multiplexer." Rose at 1:60-68; *see also id.* at 18:10-20, 18:56-19:6, FIGS. 31 and 33.

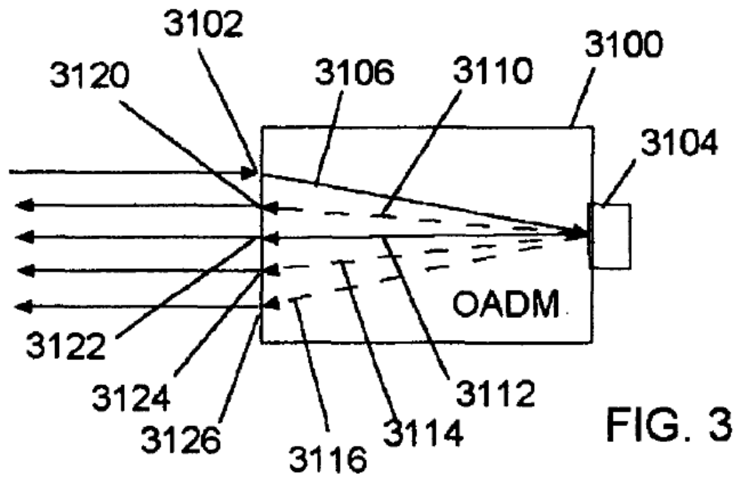


FIG. 31

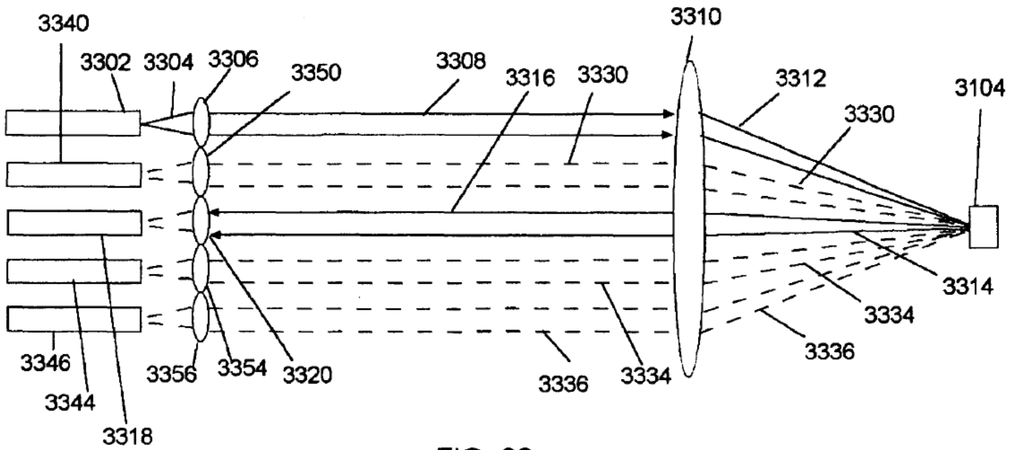


FIG. 33

1620. Therefore, Rose discloses to a POSITA "[a] method of performing dynamic add and drop in a WDM optical network." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xxxix) *'905 Patent, [51-a] "separating an input multi-wavelength optical signal into spectral channels"*

1621. I previously analyzed Rose in view of the following similar limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.g.vi (Paragraphs 1536-1537).

I incorporate that analysis by reference.

(xl) *'905 Patent, [51-b] "imaging each of said spectral channels onto a corresponding beam-deflecting element"*

1622. I previously analyzed Rose in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channel[,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550); and

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.g.xvi (Paragraphs 1575-1577).

I incorporate that analysis by reference.

(xli) *'905 Patent, [51-c] "controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal"*

1623. I previously analyzed Rose in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550);

- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.g.viii (Paragraphs 1551-1553);

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.g.ix (Paragraphs 1554-1557); and

- "said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal[,]" discussed above in Section IX.1.g.xiv (Paragraphs 1569-1571) and

I incorporate that analysis by reference.

1624. Rose discloses to a POSITA "controlling dynamically … said beam-deflecting elements."

1625. Rose discloses that a reflector of the switch can receive an optical signal and reflect the signal to an output port. The reflector can be adjusted and pivoted to select between a number of positions and reflect the signal to different output ports. "An embodiment of a switch having multiple states is illustrated in FIG. 32. The switch 3108 has a reflector 3202 that is selectively movable among several different positions. In the particular embodiment illustrated, the reflector 3202 is pivotable among four different positions: one position is illustrated as a solid line, and the other positions 3206 are illustrated with dashed lines. It will be appreciated that the switch may be selectively adjustable between a number of positions that is different from four." Rose at 18:21-29; *see also id.* at FIG. 32.

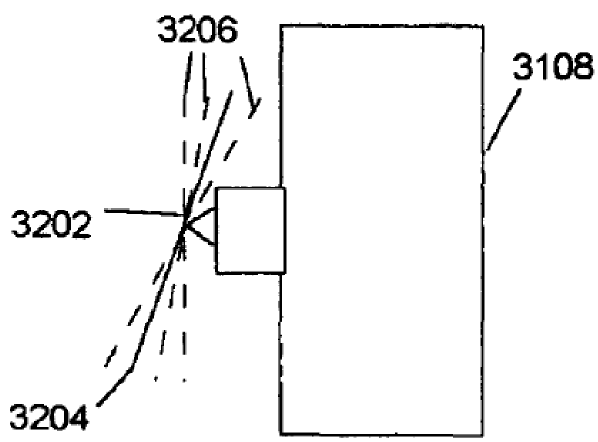


FIG. 32

1626. Therefore, Rose discloses to a POSITA "controlling dynamically . . . said beam deflecting elements." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xlii) *'905 Patent, [51-d] "receiving the output multi-wavelength optical signal at an output port that transmits the output multi-wavelength optical signal to an optical fiber; and wherein"*

1627. I previously analyzed Rose in view of the following limitations:

- "an output port[,]" discussed above in Section IX.1.g.ii (Paragraphs 1521-1525);
- "the output port for an output multi-wavelength optical signal[,]" discussed above in Section IX.1.g.v (Paragraphs 1533-1535); and
- "each of said elements . . . reflect[ing] its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550).

I incorporate that analysis by reference.

1628. Rose discloses to a POSITA "an output port that transmits the output multi-wavelength optical signal to an optical fiber."

1629. Rose discloses using a focusing system to focus an optical signal into an output fiber. "An unfolded, equivalent optical architecture for the device 3100 is illustrated in FIG. 33. Light 3304 enters the device 3100 through a first fiber 3302 and is collimated in a first collimating unit 3306. The collimated beam 3308 passes through the transmission gratings (not shown) to the focusing optic 3310, which directs the focused beam 3312 to the switch array 3104. The switch array 3104 directs each channel along a particular selected reflected path. Only one channel is illustrated in the figure. The channel is reflected along path 3112, that corresponds to the path traveled by the diverging beam 3314, collimated by the focusing optic 3310 to produce collimated beam 3316, and collimated beam 3316 which is focused into fiber 3318 by focusing system 3320." Rose at 18:42-55; *see also id.* at FIG. 33. Rose also discloses collimator units that focus light to and from the fibers." Rose at 18:42-64 and FIG. 33.

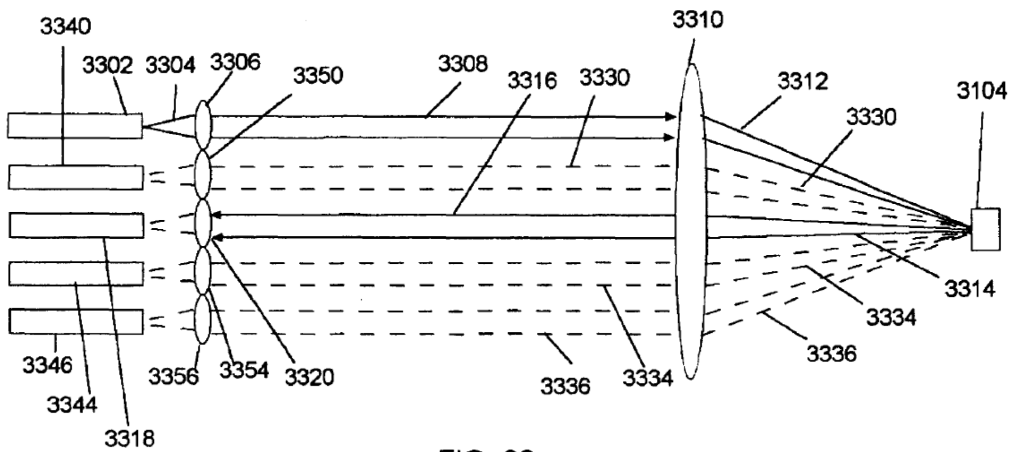


FIG. 33

1630. Therefore, Rose discloses to a POSITA "an output port that transmits the output multi-wavelength optical signal to an optical fiber." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xliii) *'905 Patent, [51-e] "said selected ones of said spectral channels comprises a subset of said spectral channels, such that other non-selected ones of said spectral channels are dropped from said output multi-wavelength optical signal; and"*

1631. I previously analyzed Rose in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550);
- "direct[ing] selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.g.xi (Paragraphs 1561-1563); and
- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.g.xv (Paragraphs 1572-1574).

I incorporate that analysis by reference.

(xliv) *'905 Patent, [51-f] "said controlling comprises reflecting said non-selected ones of said spectral channels to one or more fiber collimator serving as drop ports"*

1632. I previously analyzed Rose in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.g.viii (Paragraphs 1551-1553);
- "direct[ing] selected ones of said first spectral channels to one or more of said fiber collimator other ports to be dropped as second spectral channels from said output multi-wavelength optical signal[,]" discussed above in Section IX.1.g.xi (Paragraphs 1561-1563); and
- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.g.xv (Paragraphs 1572-1574).

I incorporate that analysis by reference.

(xlv) *'905 Patent, [52] "The method of claim 51 further comprising imaging other spectral channels onto other corresponding beam-deflecting elements, and controlling dynamically and continuously said other beam-deflecting elements so as to combine said other spectral channels with said selected ones of said spectral channels into said output multi-wavelength optical signal"*

1633. I previously analyzed Rose in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550);
- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.g.viii (Paragraphs 1551-1553);
- "direct[ing] selected ones of said second spectral channels to said output port to be added to said output multi-wavelength optical signal[,]" discussed above in Section IX.1.g.xii (Paragraphs 1564-1566); and

- "said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.g.xv (Paragraphs 1572-1574).
- "controlling dynamically . . . beam-deflecting elements[,]" discussed above in Section IX.1.g.xli (Paragraphs 1622-1625).

I incorporate that analysis by reference.

(xlvi) *'905 Patent, [53] "The method of claim 51, wherein said imaging comprises focusing said spectral channels onto said beam-deflecting elements"*

1634. I previously analyzed Rose in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels[,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550); and
- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.g.xvi (Paragraphs 1575-1577).

I incorporate that analysis by reference.

(xlvii) *'905 Patent, [54] "The method of claim 51 further comprising monitoring a power level in one or more of said selected ones of said spectral channels, and controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring"*

1635. I previously analyzed Rose in view of the following limitations:

- "a spectral monitor for monitoring said power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.g.ix (Paragraphs 1554-1557).

I incorporate that analysis by reference.

(xlviii) *'906 Patent, [68-pre] "A wavelength-separating-routing apparatus, comprising"*

1636. To the extent the language in the preamble is considered limiting, Rose discloses to a POSITA "[a] wavelength-separating-routing apparatus."

1637. Rose discloses separating the light using transmission gratings to spatially separate the spatial channels from the input optical signal. "Another embodiment of a transmission grating add/drop device 3100 is illustrated in FIG. 31. In this device 3100, there are several ports for light to enter or exit. The first port 3102 is an input port for inputting light to the device 3100. Light reaches the switch array 3104 from the first port 3102 along a first path 3106 (solid line) after the different channels are separated by being dispersed by the transmission gratings. The switch array 3104 is disposed so that each separated channel has a respective optical switch 3108 that selectively reflects the light of its associated channel into one of a number of different directions." Rose at 18:10-20; *see also id.* at FIG. 31.

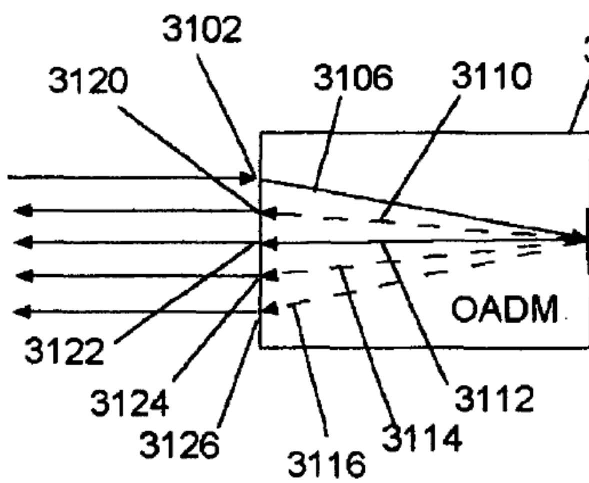


FIG. 31

1638. Therefore, Rose discloses to a POSITA "[a] wavelength-separating-routing apparatus." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xlix) *'906 Patent, [68-a] "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports"*

1639. I previously analyzed Rose in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.g.iii (Paragraphs 1526-1529).

I incorporate that analysis by reference.

1640. Under Capella's apparent interpretation, Rose discloses to a POSITA "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports."

1641. Rose discloses that light reflected off of the switch array is collimated before being focused onto the an output fiber. "The switch array 3104 directs each channel along a particular selected reflected path. Only one channel is illustrated in the figure. The channel is reflected along path 3112, that corresponds to the path traveled by the diverging beam 3314, collimated by the focusing optic 3310 to produce collimated beam 3316, and collimated beam 3316 which is focused into fiber 3318 by focusing system 3320. Rose at 18:42-55; *see also id.* at FIG. 33. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

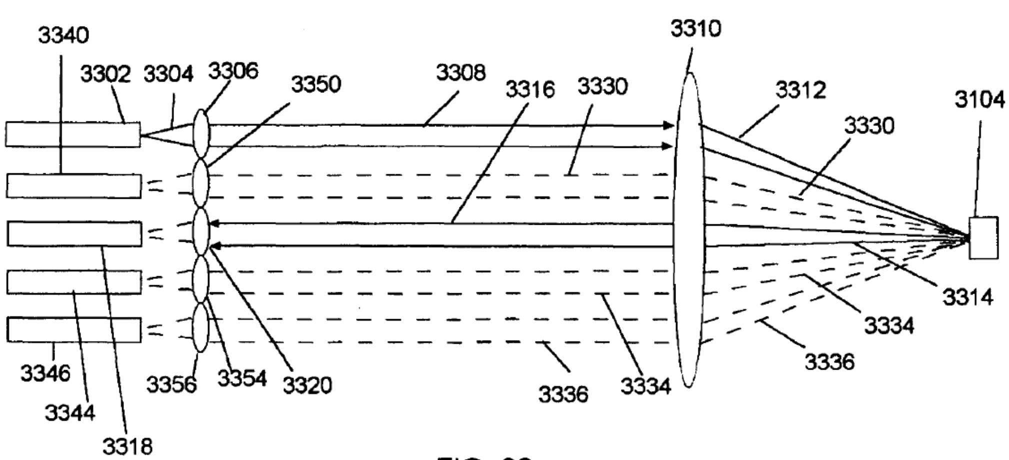


FIG. 33

1642. Therefore, under Capella's apparent interpretation, Rose discloses to a POSITA "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(l) *'906 Patent, [68-b] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

1643. I previously analyzed Rose in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.g.vi (Paragraphs 1536-1537).

I incorporate that analysis by reference.

(li) *'906 Patent, [68-c] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

1644. I previously analyzed Rose in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.g.xvi (Paragraphs 1575-1577).

I incorporate that analysis by reference.

1645. Rose discloses to a POSITA "a beam-focuser, for focusing said spectral channels into corresponding spectral spots."

1646. Rose discloses using a focusing optic to focus channels onto a switch array. "Light 3304 enters the device 3100 through a first fiber 3302 and is collimated in a first collimating unit 3306. The collimated beam 3308 passes through the transmission gratings (not shown) to the focusing optic 3310, which directs the focused beam 3312 to the switch array 3104. The switch array 3104 directs each channel along a particular selected reflected path. Only one channel is illustrated in the figure. The channel is reflected along path 3112, that

corresponds to the path traveled by the diverging beam 3314, collimated by the focusing optic 3310 to produce collimated beam 3316, and collimated beam 3316 which is focused into fiber 3318 by focusing system 3320." Rose at 18:42-55; *see also id.* at 18:56-63, FIGS. 31 and 33.

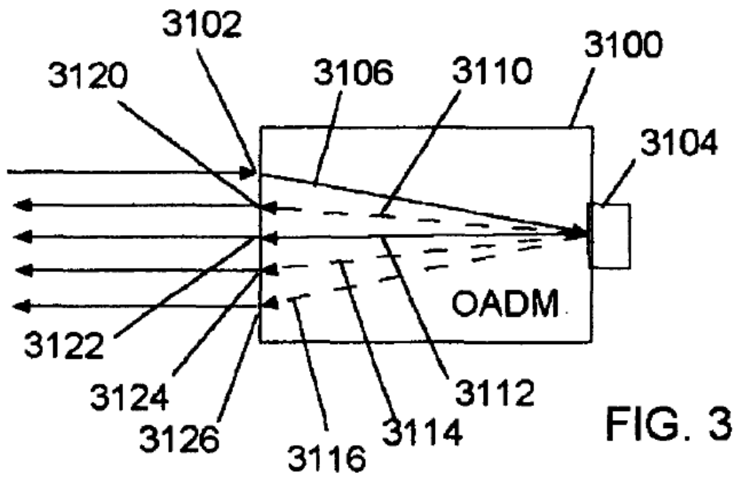


FIG. 31

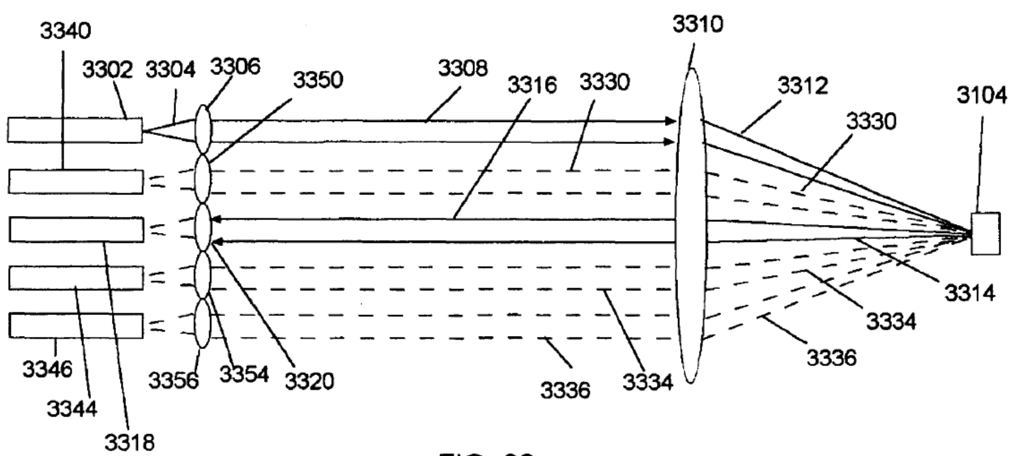


FIG. 33

1647. Therefore, Rose discloses to a POSITA "a beam-focuser, for focusing said spectral channels into corresponding spectral spots." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lii) *'906 Patent, [68-d] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports"*

1648. I previously analyzed Rose in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port [,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550).

I incorporate that analysis by reference.

1649. Rose discloses that the "channel micromirrors" are disclosed and that they are "pivotal." To the extent Rose does not teach "about two axes[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1650. Rose discloses a reflector (reference number 3202) that is selectively moveable and pivotal to reflect the multiple spectral channels. "An embodiment of a switch having multiple states is illustrated in FIG. 32. The switch 3108 has a reflector 3202 that is selectively movable among several different positions. In the particular embodiment illustrated, the reflector 3202 is pivotable among four different positions: one position is illustrated as a solid line, and the other positions 3206 are illustrated with dashed lines. It will be appreciated that the switch may be selectively adjustable between a number of positions that is different from four." Rose at 18:21-29.

1651. Therefore, Rose discloses to a POSITA discloses that the "channel micromirrors" are disclosed and that they are "pivotal." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Rose does not teach "about two axes[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(liii) *'906 Patent, [69] "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports"*

1652. I previously analyzed Rose in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.g.ix (Paragraphs 1554-1557);
- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.g.x (Paragraphs 1558-1560); and
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.g.xxii (Paragraphs 1593-1595).

I incorporate that analysis by reference.

1653. Rose discloses to a POSITA that the assembly is "in communication with said channel micromirrors and said fiber collimator output ports" and "maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports"."

1654. Rose discloses a control unit that receives a signal a power monitor. "The channel monitor 700 feeds a monitor signal to the analyzer/control unit 712, which analyzes the monitor

signal." Rose at 12:9-11. The power monitor monitors the power levels of individual channels reflected by the reflectors and transmitted to the output fibers in order to maintain the power spread among the channels. "One particular application for a channel monitor 700 is illustrated in FIG. 7. A fiber 702 includes a fiber amplifier 704, such as an erbium-doped fiber amplifier or a Raman fiber amplifier. Pump light is generated by one or more pump lasers 706 and is coupled into the fiber 702 via a coupler 708. A portion of the amplified signal is coupled out of the fiber 702 by the coupler 710 and directed to the channel monitor 700. The channel monitor 700 detects the power levels of the individual channels propagating along the fiber. The process of amplification in the amplifier 704 may favor some channels over others, with the result that the favored channels have power levels greater than the power levels of other channels. It is often preferred that the power levels of the different channels be uniform, in order to keep the power spread among the channels within the receivers' dynamic range." Rose at 11:60-12:8. The control unit can thus receive power signals from the power monitor, control pivot of the reflectors in the switching array to maintain the power spread among the channels (*see* Rose at 18:21-29), and maintain the power levels of the output signals.

1655. Therefore, Rose discloses to a POSITA that the assembly is "in communication with said channel micromirrors and said fiber collimator output ports" and "maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports"." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(liv) *'906 Patent, [70] "The wavelength-separating-routing apparatus of claim 69 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

1656. I previously analyzed Rose in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.g.ix (Paragraphs 1554-1557).

I incorporate that analysis by reference.

1657. Rose discloses to a POSITA that the spectral monitor specifically monitors power levels is "of said spectral channels coupled into said fiber collimator output ports" and that the processing unit controls "channel micromirrors."

1658. Rose discloses the power monitor monitoring the power levels of individual channels reflected by the reflectors and transmitted to the output fibers in order to maintain the power spread among the channels. "One particular application for a channel monitor 700 is illustrated in FIG. 7. A fiber 702 includes a fiber amplifier 704, such as an erbium-doped fiber amplifier or a Raman fiber amplifier. Pump light is generated by one or more pump lasers 706 and is coupled into the fiber 702 via a coupler 708. A portion of the amplified signal is coupled out of the fiber 702 by the coupler 710 and directed to the channel monitor 700. The channel monitor 700 detects the power levels of the individual channels propagating along the fiber. The process of amplification in the amplifier 704 may favor some channels over others, with the result that the favored channels have power levels greater than the power levels of other channels. It is often preferred that the power levels of the different channels be uniform, in order to keep the power spread among the channels within the receivers' dynamic range." Rose at 11:60-12:8. The control unit can thus receive power signals from the power monitor, control

pivot of the reflectors in the switching array to maintain the power spread among the channels (*see* Rose at 18:21-29), and maintain the power levels of the output signals.

1659. Rose discloses monitoring the power levels using a channel monitor. "One particular application for a channel monitor 700 is illustrated in FIG. 7. A fiber 702 includes a fiber amplifier 704, such as an erbium-doped fiber amplifier or a Raman fiber amplifier. Pump light is generated by one or more pump lasers 706 and is coupled into the fiber 702 via a coupler 708. A portion of the amplified signal is coupled out of the fiber 702 by the coupler 710 and directed to the channel monitor 700. The channel monitor 700 detects the power levels of the individual channels propagating along the fiber. The process of amplification in the amplifier 704 may favor some channels over others, with the result that the favored channels have power levels greater than the power levels of other channels. It is often preferred that the power levels of the different channels be uniform, in order to keep the power spread among the channels within the receivers' dynamic range." Rose at 11:60-12:8. Rose also discloses a control unit to control the switching elements. *See* Rose at 18:35-19:6. A POSITA would understand how to feed the monitor signal to a control unit to control the switching elements. "The channel monitor 700 feeds a monitor signal to the analyzer/control unit 712, which analyzes the monitor signal." Rose at 12:9-11.

1660. Therefore, Rose discloses to a POSITA that the spectral monitor specifically monitors power levels is "of said spectral channels coupled into said fiber collimator output ports" and that the processing unit controls "channel micromirrors." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lv) *'906 Patent, [71] "The wavelength-separating-routing apparatus of claim 70 wherein said servo-control assembly maintains said power levels at a predetermined value."*

1661. I previously analyzed Rose in view of the following limitations:

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]" discussed above in Section IX.1.g.x (Paragraphs 1558-1560).

I incorporate that analysis by reference.

(lvi) *'906 Patent, [72] "The wavelength-separating-routing apparatus of claim 68 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."*

1662. I previously analyzed Rose in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.g.xiii (Paragraphs 1567-1568); and
- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.g.xlvii (Paragraph 1634).

I incorporate that analysis by reference.

1663. To the extent Rose does not teach that an array of collimator-alignment mirrors are "in optical communication with said wavelength-separator and said fiber collimator input and output ports" and "direct[] said reflected spectral channels into said fiber collimator output ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lvii) *'906 Patent, [79] "The wavelength-separating-routing apparatus of claim 68 wherein each channel micromirror is a silicon micromachined mirror."*

1664. Rose discloses "wherein each channel micromirror is a … micromachined mirror." To the extent Rose does not teach "silicon[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1665. Rose discloses the switches and the reflectors can be as a MEMS device having micromachined deformable mirrors. "An embodiment of a reflective switch 1516 that may be used in the embodiment of OADM of in FIGS. 15 and 16 is illustrated in FIGS. 17 A and 17B. The switch 1516 may be a MEMs device having a reflecting surface 1518 that can be moved between at least two positions. The switch may be, for example, a linear MMDM (micromachined deformable mirror) supplied by Flexible Optics BV, Netherlands." Rose at 14:55-61. A POSITA would understand the reflectors could be silicon MEMS micromachined mirrors since these types of devices were known in the art and commercially available.

1666. Therefore, Rose discloses to a POSITA "wherein each channel micromirror is a … micromachined mirror." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Rose does not teach "silicon[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lviii) *'906 Patent, [80] "The wavelength-separating-routing apparatus of claim 68 wherein said fiber collimator input and output ports are arranged in a one-dimensional array."*

1667. I previously analyzed Rose in view of the following limitations:

- "wherein the fiber collimator input port, the one or more other fiber collimator ports, and the output port are arranged in a one dimensional array[,]"discussed above in Section IX.1.g.xx (Paragraphs 1587-1589).

I incorporate that analysis by reference.

(lix) *'906 Patent, [81] "The wavelength-separating-routing apparatus of claim 68 wherein said beam-focuser comprises a focusing lens having first and second focal points."*

1668. Rose discloses to a POSITA "wherein said beam-focuser comprises a focusing lens having first and second focal points."

1669. Rose discloses a focusing optic having multiple focal points. For example, the focusing lens can direct focused beams onto a reflector (reference number 3202) of the switch array, and can direct beams from the reflector to multiple output fibers. "Light 3304 enters the device 3100 through a first fiber 3302 and is collimated in a first collimating unit 3306. The collimated beam 3308 passes through the transmission gratings (not shown) to the focusing optic 3310, which directs the focused beam 3312 to the switch array 3104. The switch array 3104 directs each channel along a particular selected reflected path. Only one channel is illustrated in the figure. The channel is reflected along path 3112, that corresponds to the path traveled by the diverging beam 3314, collimated by the focusing optic 3310 to produce collimated beam 3316, and collimated beam 3316 which is focused into fiber 3318 by focusing system 3320." Rose at 18:42-49; *see also id.* at FIGS. 31-33.

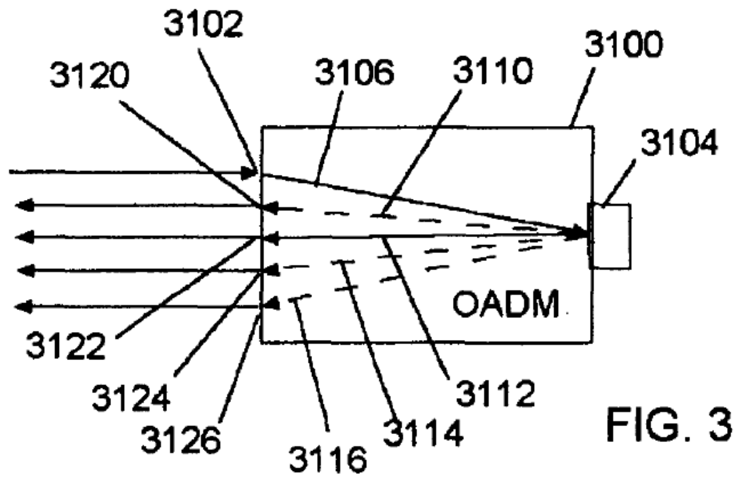


FIG. 31

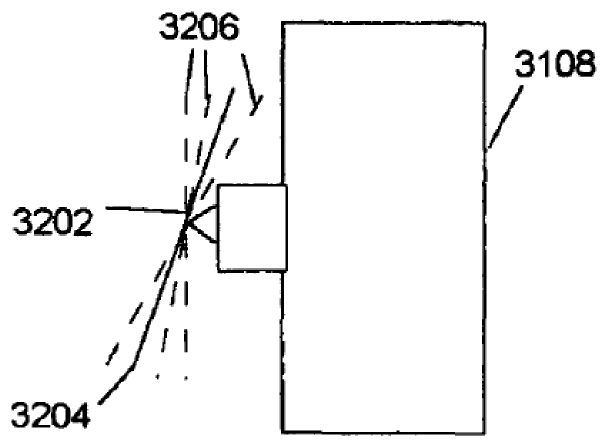


FIG. 32

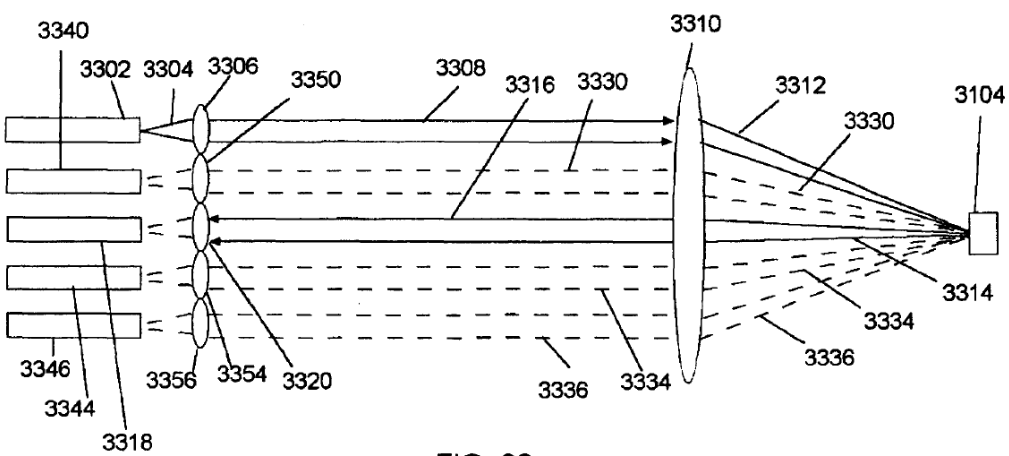


FIG. 33

1670. Therefore, Rose discloses to a POSITA "wherein said beam-focuser comprises a focusing lens having first and second focal points." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lx) *'906 Patent, [82] "The wavelength-separating-routing apparatus of claim 81 wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens."*

1671. Rose discloses to a POSITA "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens."

1672. Rose discloses a focusing optic where a fiber collimator is placed at a first focal point, and a micromirror is placed at a second focal point. "The collimated beam 3308 passes through the transmission gratings (not shown) to the focusing optic 3310, which directs the focused beam 3312 to the switch array 3104. The switch array 3104 directs each channel along a particular selected reflected path. Only one channel is illustrated in the figure. The channel is reflected along path 3112, that corresponds to the path traveled by the diverging beam 3314, collimated by the focusing optic 3310 to produce collimated beam 3316, and collimated beam 3316 which is focused into fiber 3318 by focusing system 3320." Rose at 18:42-49; *see also id.* at FIGS. 31-33.

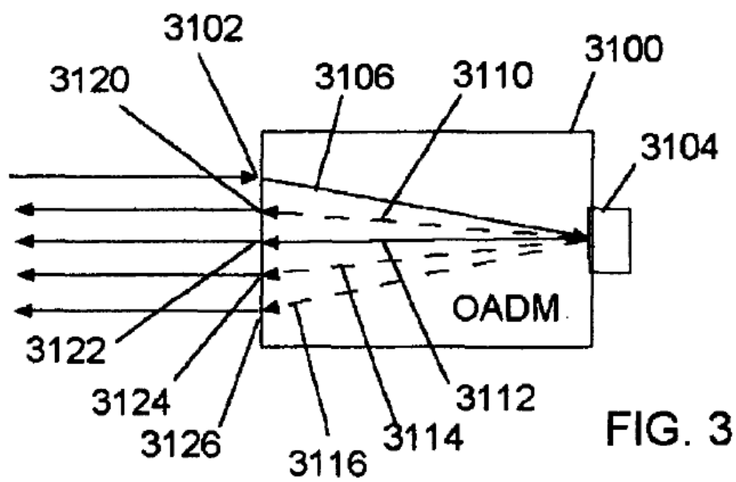


FIG. 31

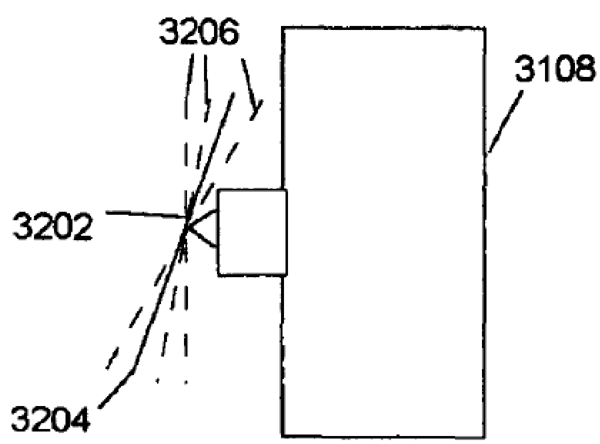


FIG. 32

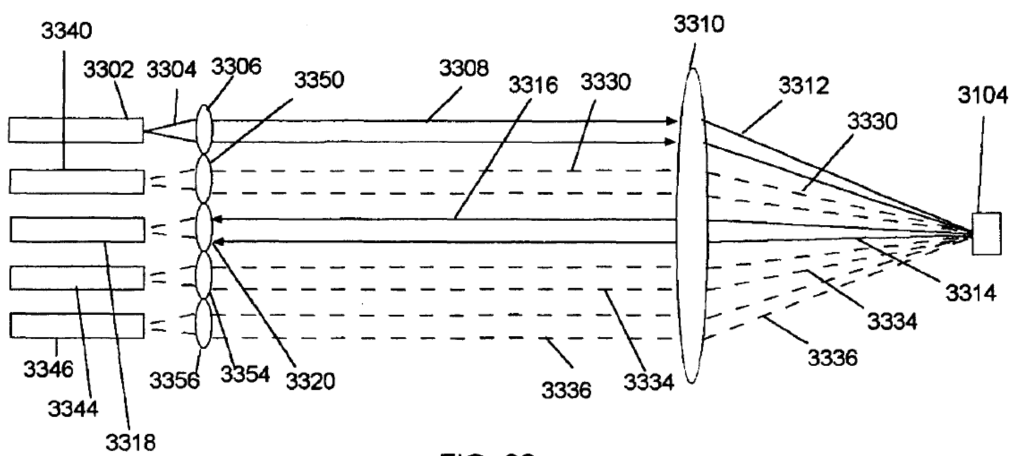


FIG. 33

1673. Therefore, Rose discloses to a POSITA "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxi) *'906 Patent, [83] "The wavelength-separating-routing apparatus of claim 68 wherein said beam-focuser comprises an assembly of lenses."*

1674. Rose discloses to a POSITA "wherein said beam-focuser comprises an assembly of lenses."

1675. Rose discloses light first being collimated by a first lens, transmitted to a focusing lens, which then transmits the light to one or more other lenses. "Light 3304 enters the device 3100 through a first fiber 3302 and is collimated in a first collimating unit 3306. The collimated beam 3308 passes through the transmission gratings (not shown) to the focusing optic 3310, which directs the focused beam 3312 to the switch array 3104. The switch array 3104 directs each channel along a particular selected reflected path. Only one channel is illustrated in the figure. The channel is reflected along path 3112, that corresponds to the path traveled by the diverging beam 3314, collimated by the focusing optic 3310 to produce collimated beam 3316, and collimated beam 3316 which is focused into fiber 3318 by focusing system 3320." Rose at 18:42-49; *see also id.* at FIG. 33.

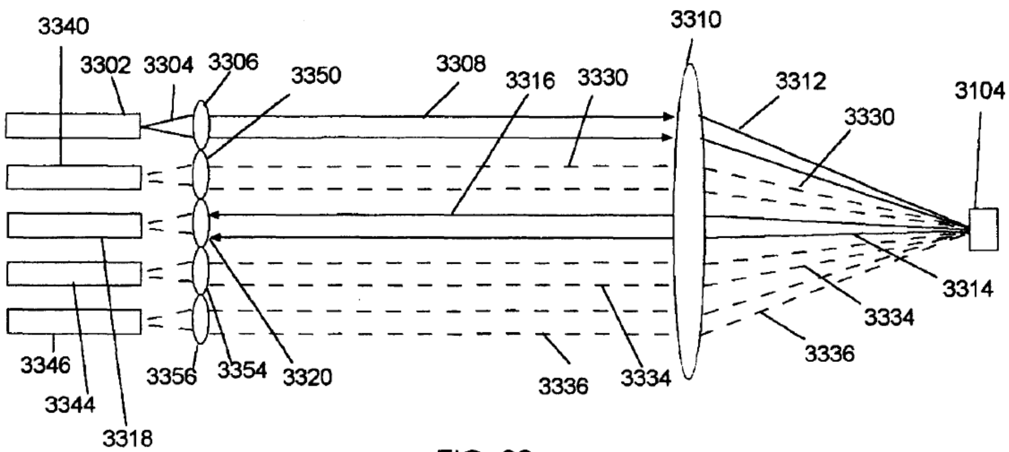


FIG. 33

1676. Therefore, Rose discloses to a POSITA "wherein said beam-focuser comprises an assembly of lenses." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

> **(lxii)** *'906 Patent, [84] "The wavelength-separating-routing apparatus of claim 68 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing gratings."*

1677. I previously analyzed Rose in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.g.xvii (Paragraphs 1578-1580).

I incorporate that analysis by reference.

> **(lxiii)** *'906 Patent, [85] "The wavelength-separating-routing apparatus of claim 68 further comprising a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors."*

1678. To the extent Rose does not teach "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors[,]" these limitations would

have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. For example, Rose discloses "a polarization rotator 2424, such as a half-wave retardation plate, is disposed on one of the paths 2420 and 2422 to rotate the polarization of that path." Rose at 19:56-59. Although Rose does not explicitly contemplate a quarter-wave plate, it does contemplate other polarization rotators, and it would have been within the common knowledge of a POSITA to use a quarter-wave plate. A POSITA would understand how phase could be controlled.

(lxiv) *'906 Patent, [86] "The wavelength-separating-routing apparatus of claim 68 wherein each fiber collimator output port carries a single one of said spectral channels."*

1679. Under Capella's apparent interpretation, Rose discloses to a POSITA "wherein each fiber collimator output port carries a single one of said spectral channels."

1680. Rose discloses channels reflected by a switch array being collimated by a focusing optic and transmitted to separate output ports. "Light 3304 enters the device 3100 through a first fiber 3302 and is collimated in a first collimating unit 3306. The collimated beam 3308 passes through the transmission gratings (not shown) to the focusing optic 3310, which directs the focused beam 3312 to the switch array 3104. The switch array 3104 directs each channel along a particular selected reflected path. Only one channel is illustrated in the figure. The channel is reflected along path 3112, that corresponds to the path traveled by the diverging beam 3314, collimated by the focusing optic 3310 to produce collimated beam 3316, and collimated beam 3316 which is focused into fiber 3318 by focusing system 3320." Rose at 18:42-49; *see also id.* at FIG. 33. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

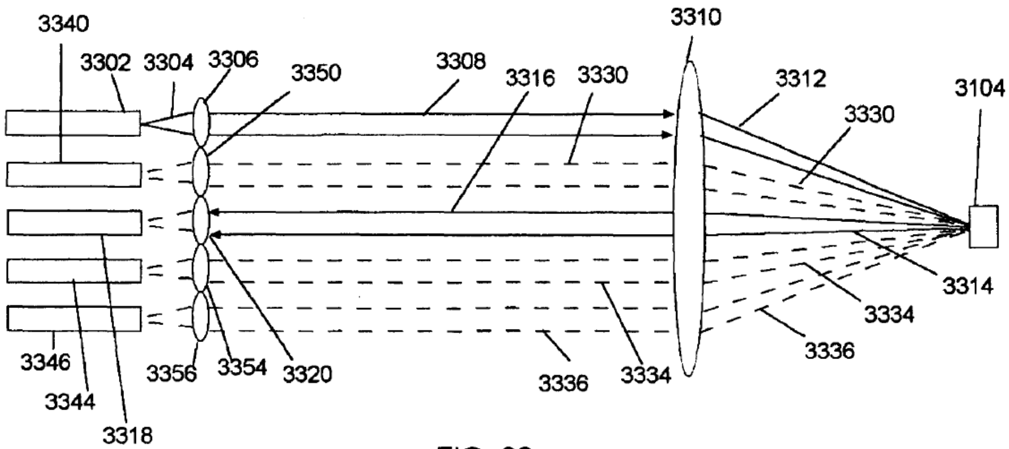


FIG. 33

1681. Therefore, under Capella's apparent interpretation, Rose discloses to a POSITA "wherein each fiber collimator output port carries a single one of said spectral channels." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxv) *'906 Patent, [87] "The wavelength-separating-routing apparatus of claim 86 further comprising one or more optical sensors, optically coupled to said fiber collimator output ports."*

1682. Rose discloses to a POSITA "one or more optical sensors, optically coupled to said fiber collimator output ports." For example, Rose discloses optical sensors in the channel monitor. "[T]he detector unit 604 may be a photodetector sensor array." Rose at 15:42-43. Additionally, as seen in FIG. 6 the detector unit 604 is optically coupled to the collimating lens 530 and the output port 602:

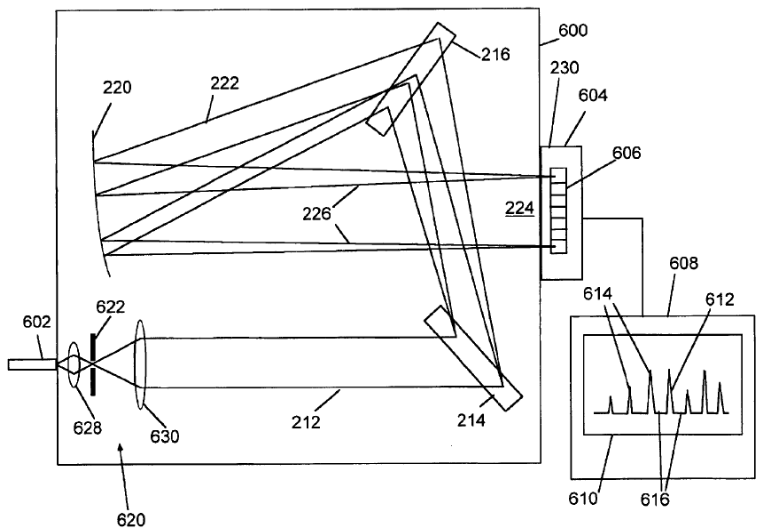


FIG. 6

1683. Therefore, Rose discloses to a POSITA "one or more optical sensors, optically coupled to said fiber collimator output ports." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxvi) *'906 Patent, [88] "The wavelength-separating-routing apparatus of claim 68, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator."*

1684. I previously analyzed Rose in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.g.xix (Paragraphs 1584-1586).

I incorporate that analysis by reference.

(lxvii) *'906 Patent, [89-pre] "A servo-based optical apparatus comprising"*

1685. I previously analyzed Rose in view of the following limitations:

- "An optical . . . apparatus[,]" discussed above in Section IX.1.g.ii (Paragraphs 1521-1525);

- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.g.viii (Paragraphs 1551-1553); and

- "wherein the control unit further comprises a servo-control assembly[,]" discussed above in Section IX.1.g.ix (Paragraphs 1554-1557).

I incorporate that analysis by reference.

(lxviii) *'906 Patent, [89-a] "multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports"*

1686. I previously analyzed Rose in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.g.ii (Paragraphs 1521-1525); and

- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports [,]" discussed above in Section IX.1.g.xlix (Paragraphs 1638-1641).

I incorporate that analysis by reference.

(lxix) *"'906 Patent, [89-b] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

1687. I previously analyzed Rose in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.g.vi (Paragraphs 1536-1537).

I incorporate that analysis by reference.

(lxx) *'906 Patent, [89-c] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

1688. I previously analyzed Rose in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.g.xvi (Paragraphs 1575-1577).

- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.g.li (Paragraphs 1643-1646).

I incorporate that analysis by reference.

(lxxi) *'906 Patent, [89-d] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said fiber collimator output ports"*

1689. I previously analyzed Rose in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.g.lii (Paragraphs 1647-1650).

I incorporate that analysis by reference.

(lxxii) *'906 Patent, [89-e] "a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports."*

1690. I previously analyzed Rose in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.g.ix (Paragraphs 1554-1557);

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.g.x (Paragraphs 1558-1560);

- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.g.xxii (Paragraphs 1593-1595); and

- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.g.liii (Paragraphs 1651-1654).

I incorporate that analysis by reference.

(lxxiii) *'906 Patent, [90] "The servo-based optical apparatus of claim 89 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

1691. I previously analyzed Rose in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.g.ix (Paragraphs 1554-1557); and

- "said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors[,]" discussed above in Section IX.1.g.liv (Paragraphs 1655-1659).

I incorporate that analysis by reference.

(lxxiv) *'906 Patent, [91] "The servo-based optical apparatus of claim 90 wherein said servo-control assembly maintains said power levels at a predetermined value"*

1692. I previously analyzed Rose in view of the following limitations:

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]" discussed above in Section IX.1.g.x (Paragraphs 1558-1560); and

- "wherein said servo-control assembly maintains said power levels at a predetermined value[,]" discussed above in Section IX.1.g.lv (Paragraph 1660).

I incorporate that analysis by reference.

(lxxv) *'906 Patent, [92] "The servo-based optical apparatus of claim 89 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports."*

1693. I previously analyzed Rose in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.g.xiii (Paragraphs 1567-1568);

- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.g.xlvii (Paragraph 1634); and

- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.g.lvi (Paragraphs 1661-1662)

I incorporate that analysis by reference.

(lxxvi) *'906 Patent, [96] "The servo-based optical apparatus of claim 89 wherein each channel micromirror is a silicon micromachined mirror."*

1694. I previously analyzed Rose in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.g.lvii (Paragraphs 1663-1665).

I incorporate that analysis by reference.

(lxxvii) *'906 Patent, [97] "The servo-based optical apparatus of claim 89 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

1695. I previously analyzed Rose in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.g.xvii (Paragraphs 1578-1580).

I incorporate that analysis by reference.

(lxxviii) *'906 Patent, [98] "The servo-based optical apparatus of claim 89 wherein said beam-focuser comprises one or more lenses."*

1696. I previously analyzed Rose in view of the following limitations:

- "wherein said beam-focuser comprises an assembly of lenses [,]"discussed above in Section IX.1.g.lxi (Paragraphs 1673-1675).

I incorporate that analysis by reference.

(lxxix) *'906 Patent, [99] "The servo-based optical apparatus of claim 89, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"*

1697. I previously analyzed Rose in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.g.xix (Paragraphs 1584-1586).

I incorporate that analysis by reference.

(lxxx) *'906 Patent, [100-pre] "An optical apparatus comprising:"*

1698. I previously analyzed Rose in view of the following limitations:

- "An optical . . . apparatus[,]" discussed above in Section IX.1.g.ii (Paragraphs 1521-1525).

I incorporate that analysis by reference.

(lxxxi) *'906 Patent, [100-a] "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal"*

1699. I previously analyzed Rose in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.g.ii (Paragraphs 1521-1525); and
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports [,]" discussed above in Section IX.1.g.xlix (Paragraphs 1638-1641).

I incorporate that analysis by reference.

1700. Under Capella's apparent interpretation, Rose discloses to a POSITA an "array" of fiber collimators for the input fiber. "Light 3304 enters the device 3100 through a first fiber 3302 and is collimated in a first collimating unit 3306. The collimated beam 3308 passes through the transmission gratings (not shown) to the focusing optic 3310, which directs the focused beam 3312 to the switch array 3104. The switch array 3104 directs each channel along a particular selected reflected path. Only one channel is illustrated in the figure. The channel is reflected along path 3112, that corresponds to the path traveled by the diverging beam 3314, collimated by the focusing optic 3310 to produce collimated beam 3316, and collimated beam 3316 which is focused into fiber 3318 by focusing system 3320." Rose at 18:42-55; *see also id.* at FIGS. 31 and 33. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

1701. Therefore, under Capella's apparent interpretation, Rose discloses to a POSITA an "array" of fiber collimators. Even if Rose does not do so, however, these limitations would

have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxxii) *'906 Patent, [100-b] "a plurality of output ports"*

1702. I previously analyzed Rose in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.g.iii (Paragraphs 1526-1529).

I incorporate that analysis by reference.

(lxxxiii) *'906 Patent, [100-c] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

1703. I previously analyzed Rose in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.g.vi (Paragraphs 1536-1537).

I incorporate that analysis by reference.

(lxxxiv) *'906 Patent, [100-d] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

1704. I previously analyzed Rose in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.g.xvi (Paragraphs 1575-1577).
- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.g.li (Paragraphs 1643-1646).

I incorporate that analysis by reference.

(lxxxv) *'906 Patent, [100-e] "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually and continuously controllable to reflect said spectral channels into selected ones of said output ports"*

1705. I previously analyzed Rose in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.g.lii (Paragraphs 1647-1650).

I incorporate that analysis by reference.

(lxxxvi) *'906 Patent, [100-f] "a one-dimensional array of collimator-alignment mirrors, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports"*

1706. I previously analyzed Rose in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.g.xiii (Paragraphs 1567-1568);

- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.g.xlvii (Paragraph 1634); and

- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.g.lvi (Paragraphs 1661-1662)

I incorporate that analysis by reference.

1707. Rose discloses to a POSITA a "one dimensional array" of collimator-alignment mirrors."

1708. As shown in Figure 12B, Rose illustrates that mirrors (220, 1122) are arranged in a one dimensional array:

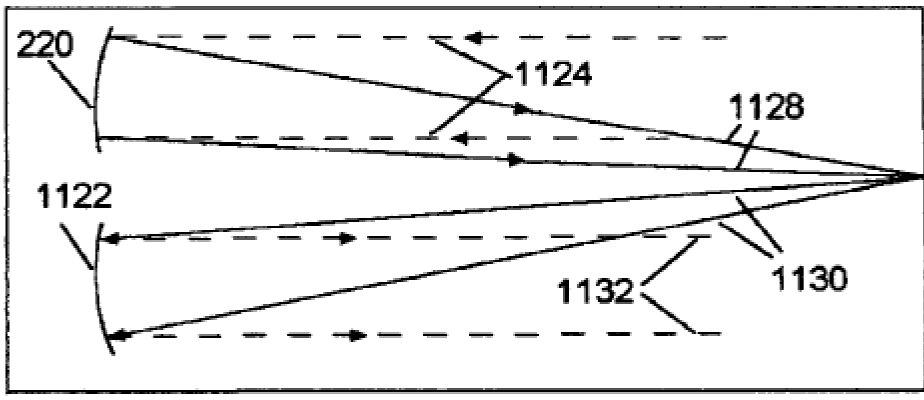


FIG. 12B

1709. Therefore, Rose discloses to a POSITA a "one dimensional array" of collimator-alignment mirrors." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxxvii) *'906 Patent, [106] "The optical apparatus of claim 100, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"*

1710. I previously analyzed Rose in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.g.xix (Paragraphs 1584-1586).

I incorporate that analysis by reference.

(lxxxviii) *'906 Patent, [115-pre] "An optical system comprising a wavelength-separating-routing apparatus, wherein said wavelength-separating-routing apparatus includes"*

1711. I previously analyzed Rose in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]" discussed above in Section IX.1.g.xlviii (Paragraphs 1635-1637).

I incorporate that analysis by reference.

1712. To the extent the language of the preamble is considered limiting, Rose discloses to a POSITA "[a] n optical system comprising a wavelength-separating-routing apparatus."

1713. Rose discloses a wavelength division add/drop multiplexed device. "A wavelength division multiplexed device is based on a transmission grating spectrometer having at least two diffractive optical elements. The WDM device provides flexible use and may be widely applied in WDM systems. The device is useful for multiplexing and demultiplexing, channel monitoring, and for adding and dropping channels. The device provides programmability in use as an add/drop multiplexer." Rose at Abstract; *see also id.* at FIG. 33 (disclosing a switch array of controllable mirrors capable of reflecting multiple channels from multiple input fibers to multiple output fibers).

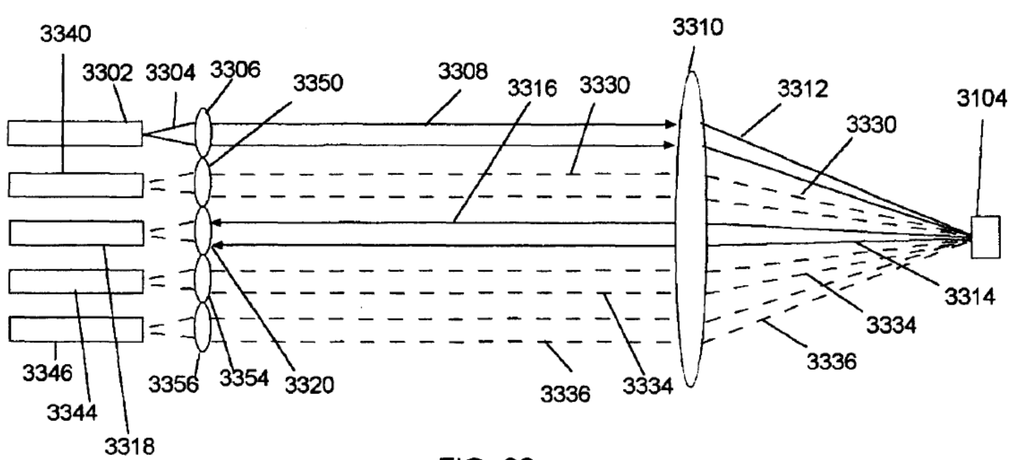


FIG. 33

1714. Therefore, Rose discloses to a POSITA "[a]n optical system comprising a wavelength-separating-routing apparatus." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(lxxxix) *'906 Patent, [115-a] "an array of fiber collimators, providing and serving as an input port for a multi-wavelength optical signal"*

1715. I previously analyzed Rose in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.g.ii (Paragraphs 1521-1525);
- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.g.xlix (Paragraphs 1638-1641); and
- "an array of fiber collimators providing and serving as an input port for a multi-wavelength optical signal[,]" discussed above in Section IX.1.g.lxxxi (Paragraphs 1698-1700).

I incorporate that analysis by reference.

(xc) *'906 Patent, [115-b] "a plurality of output ports including a pass-through port and one or more drop ports"*

1716. I previously analyzed Rose in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.g.iii (Paragraphs 1526-1529); and
- "wherein said fiber collimator one or more other ports comprise . . . a fiber collimator drop port for . . . dropping first spectral channels[,]" discussed above in Section IX.1.g.xv (Paragraphs 1572-1574).

I incorporate that analysis by reference.

1717. Rose discloses to a POSITA "pass-through port."

1718. For example, Rose discloses "An example of a transmission grating 300 suitable for use in the device 200 is illustrated in FIG. 3. The transmission grating 300 includes a substrate 302 that defines a grating structure 304. In operation, light may be incident on a non-grating surface 306 of the substrate 302 and transmitted through the substrate 302 and diffracted by the grating structure 304. Light may also be incident on the grating structure 304 and then pass through the non-grated surface 302. This operation contrasts with a reflection grating in which light is incident on the surface containing the grating structure and is reflectively diffracted away from that surface." Rose at 8:34-44.

1719. Therefore, Rose discloses to a POSITA "pass-through port." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xci) *'906 Patent, [115-c] "a wavelength-separator, for separating said multi-wavelength optical signal from said fiber collimator input port into multiple spectral channels"*

1720. I previously analyzed Rose in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.g.vi (Paragraphs 1536-1537).

I incorporate that analysis by reference.

(xcii) *'906 Patent, [115-d] "a beam-focuser, for focusing said spectral channels into corresponding spectral spots"*

1721. I previously analyzed Rose in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.g.xvi (Paragraphs 1575-1577).
- "a beam-focuser, for focusing said spectral channels into corresponding spectral spots[,]" discussed above in Section IX.1.g.li (Paragraphs 1643-1646).

I incorporate that analysis by reference.

(xciii) *’906 Patent, [115-e] “a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels.”*

1722. I previously analyzed Rose in view of the following limitations:

- “a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]” discussed above in Section IX.1.g.vii (Paragraphs 1538-1550); and
- “a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]” discussed above in Section IX.1.g.lii (Paragraphs 1647-1650)

I incorporate that analysis by reference.

1723. Rose discloses to a POSITA "said fiber collimator pass-through port receives a subset of said spectral channels."

1724. For example, Rose discloses "An example of a transmission grating 300 suitable for use in the device 200 is illustrated in FIG. 3. The transmission grating 300 includes a substrate 302 that defines a grating structure 304. In operation, light may be incident on a non-grating surface 306 of the substrate 302 and transmitted through the substrate 302 and diffracted by the grating structure 304. Light may also be incident on the grating structure 304 and then pass through the non-grated surface 302. This operation contrasts with a reflection grating in

which light is incident on the surface containing the grating structure and is reflectively diffracted away from that surface." Rose at 8:34-44.

1725. Therefore, Rose discloses to a POSITA "said fiber collimator pass-through port receives a subset of said spectral channels." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(xciv) *'906 Patent, [116] "The optical system of claim 115 further comprising a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports"*

1726. I previously analyzed Rose in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.g.ix (Paragraphs 1554-1557);
- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.g.x (Paragraphs 1558-1560);
- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.g.xxii (Paragraphs 1593-1595); and
- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.g.liii (Paragraphs 1651-1654).

I incorporate that analysis by reference.

(xcv) *'906 Patent, [117] "The optical system of claim 116 wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."*

1727. I previously analyzed Rose in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.g.ix (Paragraphs 1554-1557); and

- "said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors[,]" discussed above in Section IX.1.g.liv (Paragraphs 1655-1659).

I incorporate that analysis by reference.

(xcvi) *'906 Patent, [118] "The optical system of claim 115 further comprising an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimators, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports."*

1728. I previously analyzed Rose in view of the following limitations:

- "alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device [,]"discussed above in Section IX.1.g.xiii (Paragraphs 1567-1568);

- "controlling an alignment between said input multi-wavelength optical signal and corresponding beam-deflecting elements in response to said monitoring[,]" discussed above in Section IX.1.g.xlvii (Paragraph 1634); and

- "an array of collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports[,] discussed above in Section IX.1.g.lvi (Paragraphs 1661-1662)

I incorporate that analysis by reference.

(xcvii) *'906 Patent, [122] "The optical system of claim 115 wherein each channel micromirror is a silicon micromachined mirror."*

1729. I previously analyzed Rose in view of the following limitations:

- "each channel micromirror is a silicon micromachined mirror[,]"discussed above in Section IX.1.g.lvii (Paragraphs 1663-1665).

I incorporate that analysis by reference.

(xcviii) *'906 Patent, [123] "The optical system of claim 115 wherein said beam-focuser comprises a focusing lens having first and second focal points, and wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points"*

1730. I previously analyzed Rose in view of the following limitations:

- "wherein said beam-focuser comprises a focusing lens having first and second focal points[,]"discussed above in Section IX.1.g.lix (Paragraphs 1667-1669); and
- "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens[,]"discussed above in Section IX.1.g.lx (Paragraphs 1670-1672).

I incorporate that analysis by reference.

(xcix) *'906 Patent, [124] "The optical system of claim 115 wherein said wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

1731. I previously analyzed Rose in view of the following limitations:

- "wherein said wavelength-selective device comprises a device selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms[,]"discussed above in Section IX.1.g.xvii (Paragraphs 1578-1580).

I incorporate that analysis by reference.

(c) *'906 Patent, [125] "The optical system of claim 115 further comprising a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors"*

1732. I previously analyzed Rose in view of the following limitations:

- "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors[,]"discussed above in Section IX.1.g.lxiii (Paragraph 1677).

I incorporate that analysis by reference.

(ci) *'906 Patent, [126-pre] "The optical system of claim 115 further comprising an auxiliary wavelength-separating-routing apparatus, including:"*

1733. Rose discloses to a POSITA "auxiliary wavelength-separating-routing apparatus."

1734. Rose discloses an optical communications network that separates an input multi-wavelength signal into channels, and directs each channel to a selected output port. "Another embodiment of the invention is directed to an optical communications system that includes an optical transmitter, the optical transmitter transmitting a multiple channel communications signal; an optical receiver to detect optical signals carried in multiple optical channels; and a fiber-optic communications link coupled to transport the multiple channel communications signal from the optical transmitter to the optical receiver." Rose at 2:10-17.

1735. Therefore, Rose discloses to a POSITA "auxiliary wavelength-separating-routing apparatus." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cii) *'906 Patent, [126-a] "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports"*

1736. Under Capella's apparent interpretation, Rose discloses to a POSITA "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports."

1737. Rose discloses light from an input fiber first being collimated by a first focusing optic (reference number 3306) before being collimated again by another focusing optic (reference number 3310). "Light 3304 enters the device 3100 through a first fiber 3302 and is collimated in a first collimating unit 3306. The collimated beam 3308 passes through the transmission gratings (not shown) to the focusing optic 3310, which directs the focused beam 3312 to the switch array 3104. The switch array 3104 directs each channel along a particular selected reflected path. Only one channel is illustrated in the figure. The channel is reflected along path 3112, that corresponds to the path traveled by the diverging beam 3314, collimated by the focusing optic 3310 to produce collimated beam 3316, and collimated beam 3316 which is focused into fiber 3318 by focusing system 3320." Rose at 18:42-55; *see also id.* at FIG. 33. Rose also discloses collimator units that focus light to and from the fibers." Rose at 18:42-64 and FIG. 33. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

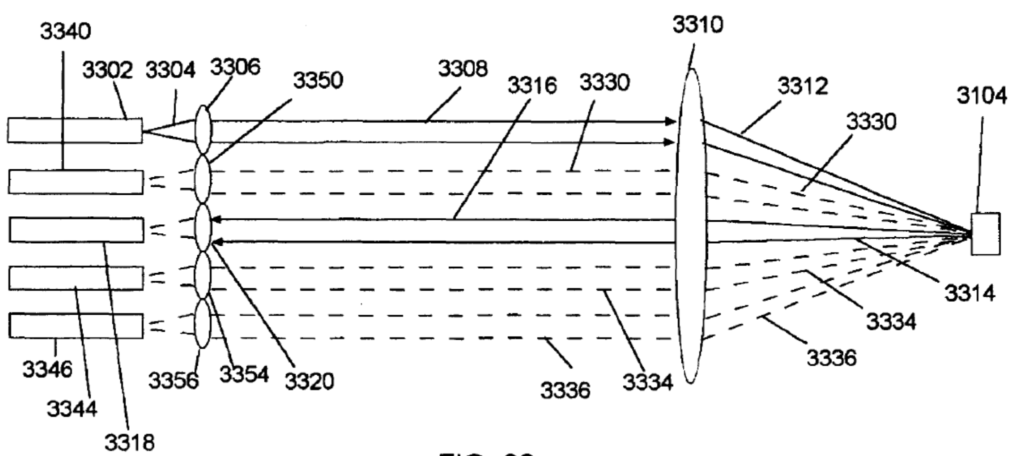


FIG. 33

1738. Additionally, light can be input in the reverse direction (e.g., the output ports can serve as input ports). Thus, the plurality of input ports each will have light collimated by a first

and a second collimating lens. "It will be appreciated that light may be directed into the device 3100 in the reverse direction, so that light entering the device 3100 from ports 3120, 3122, 3124 and 3126 is combined into an output signal that exits the device from port 3102. In such a case, the device 3100 operates as a multiple input add filter. Furthermore, light input to the device from ports 3120, 3122, 3124 and 3126 need not be directed to port 3102 but, so long as the switches 3108 provide suitable selectivity, may be directed to any of the other ports." Rose at 18:64-19:6; *see also id.* at FIG. 31.

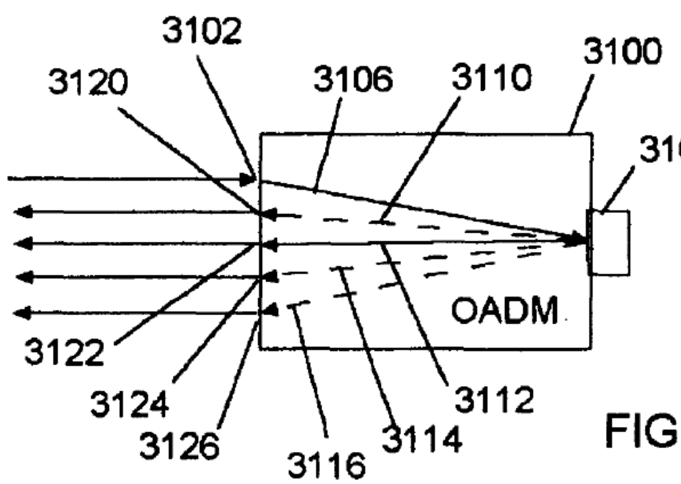


FIG. 31

1739.

1740. Therefore, under Capella's apparent interpretation, Rose discloses to a POSITA "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(ciii) *'906 Patent, [126-b] "an exiting port"*

1741. Rose discloses to a POSITA "an exiting port."

1742. Rose discloses multiple output drop or exit filters. "The switch 3108 is selectable among other paths, 3110, 3114 and 3116 that correspond to light beams 3330, 3334 and 3336, illustrated in dashed lines, that are directed to respective fibers 3340, 3344 and 3346 by respective focusing systems 3350, 3354 and 3356. Thus, the device 3100 permits selective switching of different channels into different outputs, and may be regarded as being a multiple output drop filter." Rose at 18:56-63; *see also id.* at FIG. 33.

1743. Therefore, Rose discloses to a POSITA "an exiting port." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(civ) *"'906 Patent, [126-c] "an auxiliary wavelength-separator"*

1744. Rose discloses "an … wavelength-separator." To the extent Rose does not teach "auxiliary[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1745. Rose discloses separating the light using transmission gratings to spatially separate the spatial channels from the input optical signal. "Another embodiment of a transmission grating add/drop device 3100 is illustrated in FIG. 31. In this device 3100, there are several ports for light to enter or exit. The first port 3102 is an input port for inputting light to the device 3100. Light reaches the switch array 3104 from the first port 3102 along a first path 3106 (solid line) after the different channels are separated by being dispersed by the transmission gratings. The switch array 3104 is disposed so that each separated channel has a respective optical switch 3108 that selectively reflects the light of its associated channel into one of a number of different directions." Rose at 18:10-20; *see also id.* at FIG. 31.

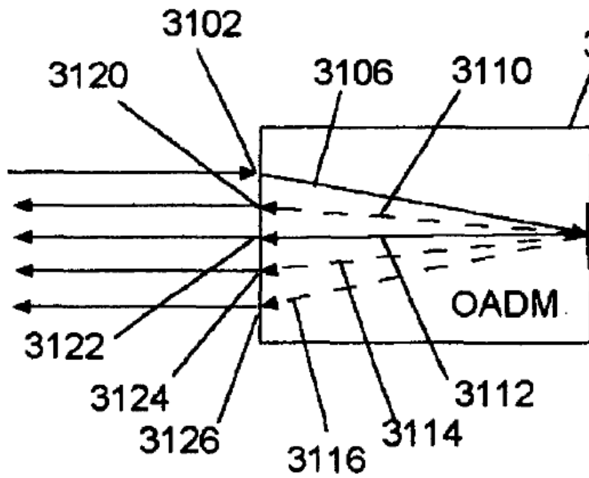


FIG. 31

1746. Therefore, Rose discloses to a POSITA "an … wavelength-separator." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Rose does not teach "auxiliary[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cv) *'906 Patent, [126-d] "an auxiliary beam-focuser"*

1747. Rose discloses to a POSITA "an auxiliary beam-focuser."

1748. Rose discloses multiple auxiliary beam-focusers. Light can first hit a focusing optic (reference number 3310) before being reflected by the focusing optic to a number of output focusing optics (reference numbers 3350, 3320, 3354, 3"The switch 3108 is selectable among other paths, 3110, 3114 and 3116 that correspond to light beams 3330, 3334 and 3336, illustrated in dashed lines, that are directed to respective fibers 3340, 3344 and 3346 by respective focusing systems 3350, 3354 and 3356. Thus, the device 3100 permits selective switching of different channels into different outputs, and may be regarded as being a multiple output drop filter." Rose at 18:56-63; *see also id.* at FIG. 33.

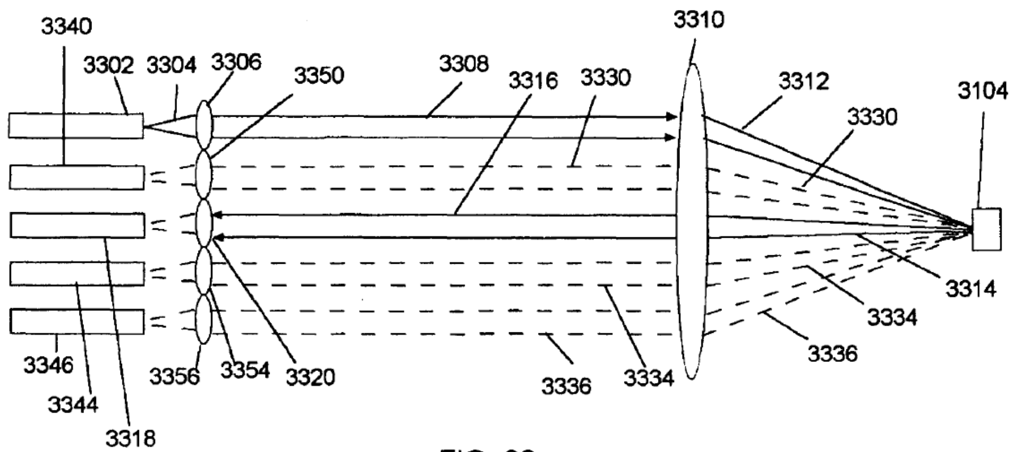


FIG. 33

1749. Therefore, Rose discloses to a POSITA "an auxiliary beam-focuser." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cvi) *'906 Patent, [126-e] "a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors"*

1750. To the extent Rose does not teach "a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cvii) *'906 Patent, [127] "The optical system of claim 126 wherein said auxiliary channel micromirrors are individually pivotable."*

1751. Rose discloses "wherein said … channel micromirrors are individually pivotable." To the extent Rose does not teach "pivotable[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1752. Rose discloses that a reflector of the switch can receive the optical signal and reflect the signal to an output port. "An embodiment of a switch having multiple states is illustrated in FIG. 32. The switch 3108 has a reflector 3202 that is selectively movable among several different positions. In the particular embodiment illustrated, the reflector 3202 is pivotable among four different positions: one position is illustrated as a solid line, and the other positions 3206 are illustrated with dashed lines. It will be appreciated that the switch may be selectively adjustable between a number of positions that is different from four." Rose at 18:21-29; *see also id.* at FIG. 32.

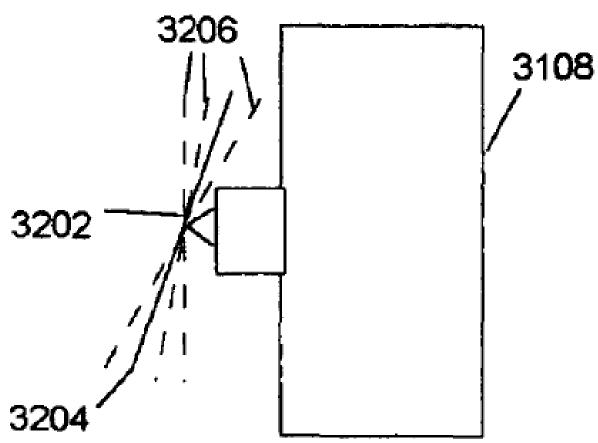


FIG. 32

1753. Rose also discloses that each switch is independently and selectively movable to provide selective switching of different channels into different outputs. "An embodiment of a switch having multiple states is illustrated in FIG. 32. The switch 3108 has a reflector 3202 that is selectively movable among several different positions. In the particular embodiment illustrated, the reflector 3202 is pivotable among four different positions: one position is illustrated as a solid line, and the other positions 3206 are illustrated with dashed lines. It will be appreciated that the switch may be selectively adjustable between a number of positions that is different from four." Rose at 18:21-29; *see also id.* at FIGS. 31-33.

1754. Therefore, Rose discloses to a POSITA "wherein said … channel micromirrors are individually pivotable." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Rose does not teach "pivotable[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cviii) *'906 Patent, [129] "The optical system of claim 126 wherein each auxiliary channel micromirror is a silicon micromachined mirror"*

1755. Rose discloses "wherein each auxiliary channel micromirror is a … micromachined mirror." To the extent Rose does not teach "silicon[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

1756. Rose discloses the switches and the reflectors can be as a MEMS device having micromachined deformable mirrors. "An embodiment of a reflective switch 1516 that may be used in the embodiment of OADM of in FIGS. 15 and 16 is illustrated in FIGS. 17 A and 17B. The switch 1516 may be a MEMs device having a reflecting surface 1518 that can be moved

between at least two positions. The switch may be, for example, a linear MMDM (micromachined deformable mirror) supplied by Flexible Optics BV, Netherlands." Rose at 14:55-61. A POSITA would understand the reflectors could be silicon MEMS micromachined mirrors since these types of devices were known in the art and commercially available.

1757. Therefore, Rose discloses to a POSITA "wherein each auxiliary channel micromirror is a … micromachined mirror." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report. Further, to the extent Rose does not teach "silicon[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cix) *'906 Patent, [130] "The optical system of claim 126 wherein said auxiliary wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."*

1758. Rose discloses to a POSITA "wherein said auxiliary wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms."

1759. Rose discloses light being diffracted from a grating surface. *See* Rose 8:52-10:13 ("Light incident on the transmission grating at an angle, a, from an axis perpendicular to the non-grated surface, in other words perpendicular to a normal to the grating, is typically diffracted from the grating surface according to the diffraction equation … the structural parameters of the grating may be selected so that the diffraction efficiency for the TE and TM polarization states of the incident light is within no more that 10% or 5%. Other examples of transmission diffraction gratings are described in U.S. patent application Ser. No. 09/789,888,

entitled "Grating structures and Methods of Making the Grating Structures", filed on Feb. 21, 2001 and naming J. Holm, H. Madsen, S. Weichel, P. E. Isben and B. Rose as inventors, and incorporated herein by reference …").

1760. Therefore, Rose discloses to a POSITA "wherein said auxiliary wavelength-separator comprises an element selected from the group consisting of ruled diffraction gratings, holographic diffraction gratings, echelle gratings, curved diffraction gratings, and dispersing prisms." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cx) *'906 Patent, [131] "The optical system of claim 126 wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports."*

1761. To the extent Rose does not teach "wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cxi) *'906 Patent, [132] "The optical system of claim 115, wherein neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator."*

1762. I previously analyzed Rose in view of the following limitations:

- "wherein none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator[,]"discussed above in Section IX.1.g.xix (Paragraphs 1584-1586).

I incorporate that analysis by reference.

(cxii) *'906 Patent, [133] "A method of performing dynamic wavelength separating and routing, comprising"*

1763. I previously analyzed Rose in view of the following limitations:

- "A wavelength-separating-routing apparatus, comprising[,]"discussed above in Section IX.1.g.xlviii (Paragraphs 1635-1637).

I incorporate that analysis by reference.

1764. To the extent the language in the preamble is considered limiting, Rose discloses to a POSITA "[a] method of performing dynamic wavelength separating and routing."

1765. Rose discloses a method that uses a programmable WDM device to add and drop channels. "Generally, the present invention relates to a WDM device that is based on the use of at least two transmissive diffraction elements. The WDM device provides flexible use and may be widely applied in WDM systems. The device is useful for multiplexing and demultiplexing, channel monitoring, and for adding and dropping channels. The device provides programmability in use as an add/drop multiplexer." Rose at 1:60-68; *see also id.* at 18:10-20, 18:56-19:6, FIGS. 31 and 33.

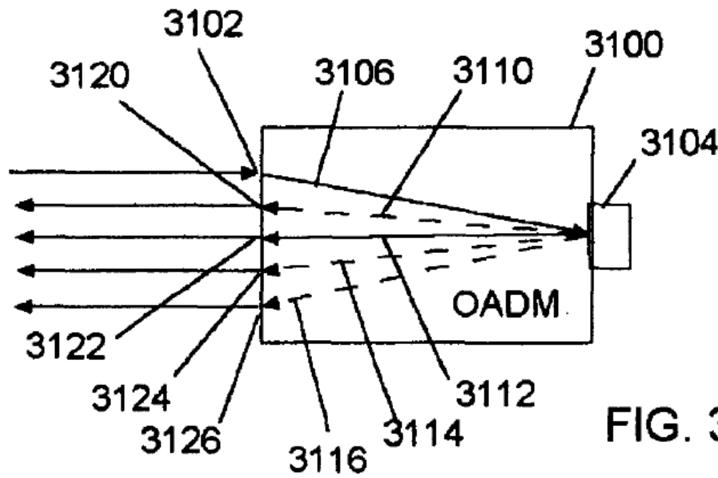


FIG. 31

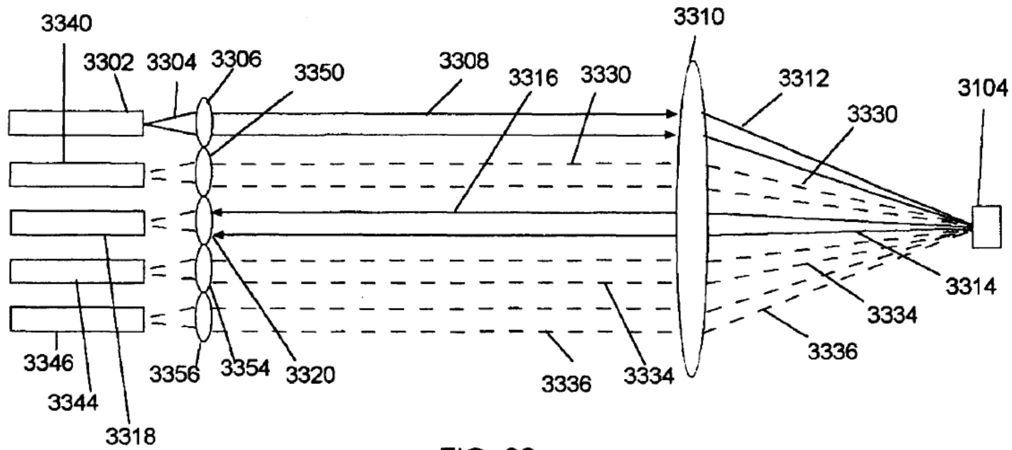


FIG. 33

1766. Therefore, Rose discloses to a POSITA "[a] method of performing dynamic wavelength separating and routing." Even if Rose does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(cxiii) *'906 Patent, [133-a] "receiving a multi-wavelength optical signal from a fiber collimator input port"*

1767. I previously analyzed Rose in view of the following limitations:

- "an output port and fiber collimators serving as an input port and one or more other ports[,]" discussed above in Section IX.1.g.iii (Paragraphs 1526-1529); and

- "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports[,]" discussed above in Section IX.1.g.xlix (Paragraphs 1638-1641).

I incorporate that analysis by reference.

(cxiv) *'906 Patent, [133-b] "separating said multi-wavelength optical signal into multiple spectral channels"*

1768. I previously analyzed Rose in view of the following limitations:

- "a wavelength-selective device for spatially separating said spectral channels[,]" discussed above in Section IX.1.g.vi (Paragraphs 1536-1537).

I incorporate that analysis by reference.

(cxv) *'906 Patent, [133-c] "focusing said spectral channels onto a spatial array of corresponding beam-deflecting elements, whereby each beam-deflecting element receives one of said spectral channels"*

1769. I previously analyzed Rose in view of the following limitations:

- "a beam-focuser for focusing said separated spectral channels onto said beam deflecting elements[,]" discussed above in Section IX.1.g.xvi (Paragraphs 1575-1577); and
- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels," discussed above in Section IX.1.g.vii (Paragraphs 1538-1550)

I incorporate that analysis by reference.

(cxvi) *'906 Patent, [133-d] "dynamically and continuously controlling said beam-deflecting elements in two dimensions to direct said spectral channels into any selected ones of output ports and to control the power of the spectral channels coupled into said selected output ports"*

1770. I previously analyzed Rose in view of the following limitations:

- "each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports[,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550);

- "a control unit for controlling each of said beam-deflecting elements[,]" discussed above in Section IX.1.g.viii (Paragraphs 1551-1553);

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.g.ix (Paragraphs 1554-1557);

- "said wavelength selective device further combines selected ones of said spectral channels reflected from said beam-deflecting elements to form said output multi-wavelength optical signal[,]" discussed above in Section IX.1.g.xiv (Paragraphs 1569-1571);

- "controlling dynamically and continuously said beam-deflecting elements in two dimensions[,]"discussed above in Section IX.1.g.xli (Paragraphs 1622-1625);

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port [,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550); and

- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.g.lii (Paragraphs 1647-1650)

I incorporate that analysis by reference.

(cxvii) *'906 Patent, [134] "The method of claim 133 further comprising the step of providing feedback control of said beam-deflecting elements to maintain a predetermining coupling of each spectral channel directed into one of said output ports."*

1771. I previously analyzed Rose in view of the following limitations:

- "a spatial array of beam-deflecting elements[,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550);

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.g.ix (Paragraphs 1554-1557);

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.g.x (Paragraphs 1558-1560);

- "control coupling efficiency of one of the first and second spectral channel to at least one port[,]" discussed above in Section IX.1.g.xxii (Paragraphs 1593-1595); and

- "The wavelength-separating-routing apparatus of claim 68 further comprising a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports[,]" discussed above in Section IX.1.g.liii (Paragraphs 1651-1654).

I incorporate that analysis by reference.

(cxviii) *'906 Patent, [135] "The method of claim 134 further comprising the step of maintaining power levels of said spectral channels directed into said output ports at a predetermining value."*

1772. I previously analyzed Rose in view of the following limitations:

- "a servo-control assembly, including a spectral monitor for monitoring power levels of selected ones of said spectral channels, and a processing unit responsive to said power levels for controlling said beam-deflecting elements[,]" discussed above in Section IX.1.g.ix (Paragraphs 1554-1557); and

- "wherein said servo-control assembly maintains said power levels at predetermined values[,]"discussed above in Section IX.1.g.x (Paragraphs 1558-1560).

I incorporate that analysis by reference.

> **(cxix)** *'906 Patent, [137] "The method of claim 133 wherein a subset of said spectral channels is directed into one of said output ports, thereby providing one or more pass-through spectral channels."*

1773. I previously analyzed Rose in view of the following limitations:

- "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port[,]" discussed above in Section IX.1.g.vii (Paragraphs 1538-1550);
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports[,]" discussed above in Section IX.1.g.lii (Paragraphs 1647-1650); and
- "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels[,]"discussed above in Section IX.1.g.xciii (Paragraph 1729).

I incorporate that analysis by reference.

> **(cxx)** *'906 Patent, [138] "The method of claim 137 further comprising the step of multiplexing said pass-through spectral channels with one or more add spectral channels, so as to provide an output optical signal."*

1774. I previously analyzed Rose in view of the following limitations:

- "wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output

optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors [,]"discussed above in Section IX.1.g.cvi (Paragraph 1749).

I incorporate that analysis by reference.

(cxxi) *'906 Patent, [139] "The method of claim 133 wherein said beam-deflecting elements comprise an array of silicon micromachined mirrors."*

1775. I previously analyzed Rose in view of the following limitations:

- "a spatial array of beam-deflecting elements[,]"discussed above in Section IX.1.g.vii (Paragraphs 1538-1550);
- "a spatial array of channel micromirrors[,] discussed above in Section IX.1.g.lii (Paragraphs 1647-1650); and
- "wherein each channel micromirror is a silicon micromachined mirror[,]" discussed above in Section IX.1.g.lvii (Paragraphs 1663-1665).

I incorporate that analysis by reference.

h) U.S. Patent No. 6,618,520 ("Tew '520")

1776. Tew '520 is directed to "[a]n optical switch using an array of mirrors (608) to selectively reflect light from an input fiber (610) to either of a first output fiber (612) or a second output fiber (614). Each fiber is held in a ferrule (616) that aligns the fiber with a focusing device (618). The focusing device associated with the input fiber causes the beam of light to either collimate, diverge, or converge." Tew '520 at Abstract; *see also* Provisional Application No. 60/236,533 at Abstract.

1777. As shown in Figure 10, reprinted below, light from the input and/or add fiber (A and/or B) is collimated by a optic (such as a GRIN lens), and the light is reflected to an output and/or drop fiber (output A and/or output B), and/or a connection or jumper fiber 1006 (e.g., a pass-through port).

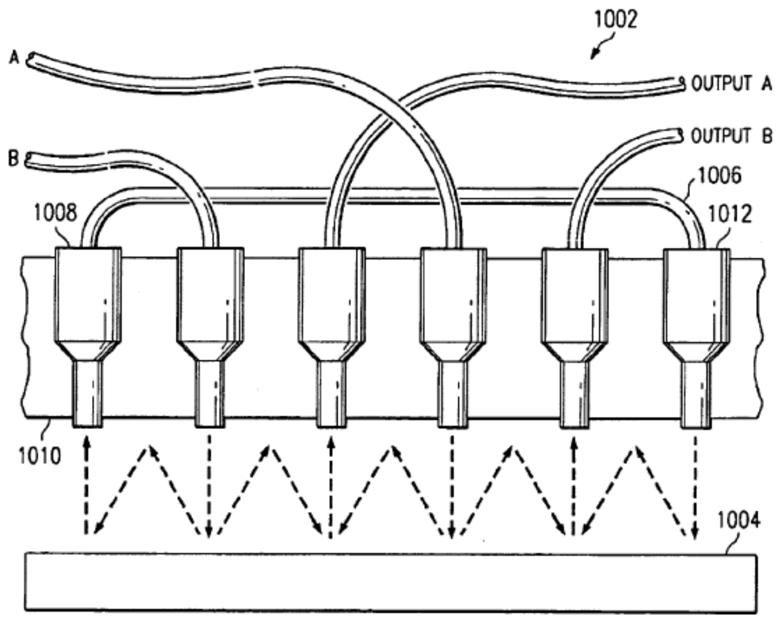


FIG. 10

Tew '520 at FIG. 10.

(i) *Tew '520 Is Prior Art to the Asserted Claims*

1778. Tew '520 claims priority to Provisional Application No. 60/164,223 filed on November 9, 1999 and Provisional Application No. 60/236,533 filed on September 29, 2000, was filed on September 28, 2001, was published as 2002/0034356 on March 21, 2002, and issued on September 9, 2003.

1779. As noted above in Section III.D.1.a (Paragraph 47), it is my understanding that for a patent or patent publication to claim priority to a provisional application, the provisional application must contain, for at least one claim recited in the patent or published patent application, a written description of the invention and the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable a person of ordinary skill in the art to practice the claimed invention. It is my opinion that these requirements are satisfied for Tew '520 with respect to Provisional Application No. 60/236,533 ("Tew '520 Prov.").

Accordingly, it is my understanding that Tew ’520 is entitled to a priority date of September 29, 2000.

1780. I understand that Tew ’520 is entitled to the priority date of Tew ’520 Prov. if at least one claim in Tew ’520 is supported by the disclosure of Tew ’520 Prov. At least Claim 1 of Tew ’520 is supported by the disclosure of Tew ’520 Prov. With respect to the preamble, which sets forth “[a]n optical switch comprising,” Tew ’520 Prov. discloses “[a]n optical switch using an array of mirrors (608) to selectively reflect light from an input fiber (610) to either of a first output fiber (612) or a second output fiber (618).” Tew ‘520 Prov. at Abstract; *see also* Tew ’520 Prov. at FIGS. 5-6, 8-10 (FIGS. 5 and 10 reproduced below).

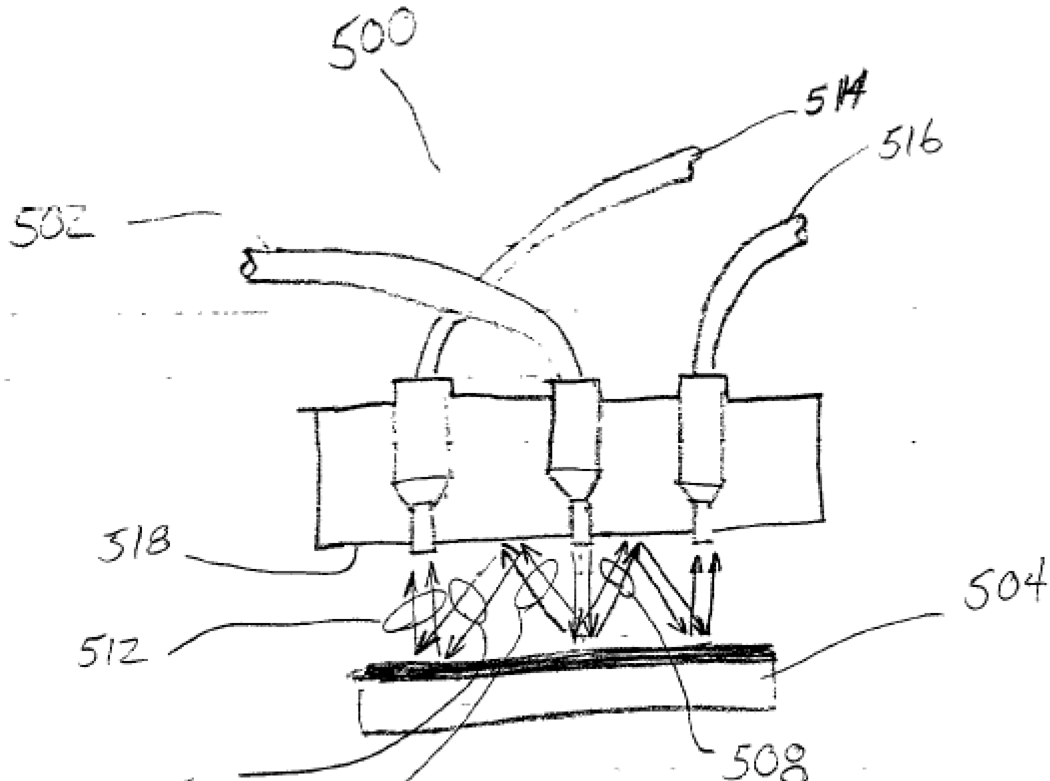

500
514
516
502
518
504
512
508
513
506

FIG. 5

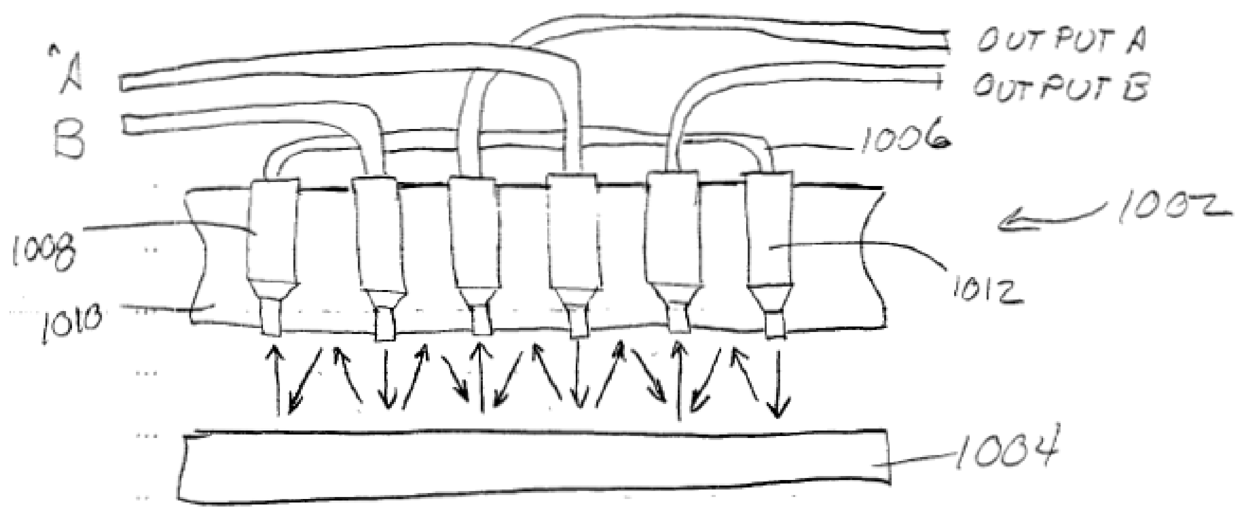

A
B
OUTPUT A
OUTPUT B
1006
1002
1008
1012
1010
1004

FIG. 10

1781. With respect to "at least one input fiber, each said input fiber defining an input optical axis and having an exit end," Tew '520 Prov. discloses "light from an input fiber 502 passes through the GRIN lens." Tew '520 Prov. at 12:13; *see also* Tew '520 Prov. at 16:13 ("a light beam exiting fiber 702 through a collimating lens 704"); *see also* Tew '520 Prov. at FIGs. 5-7, 10) (FIGS. 5 and 7 reproduced below).

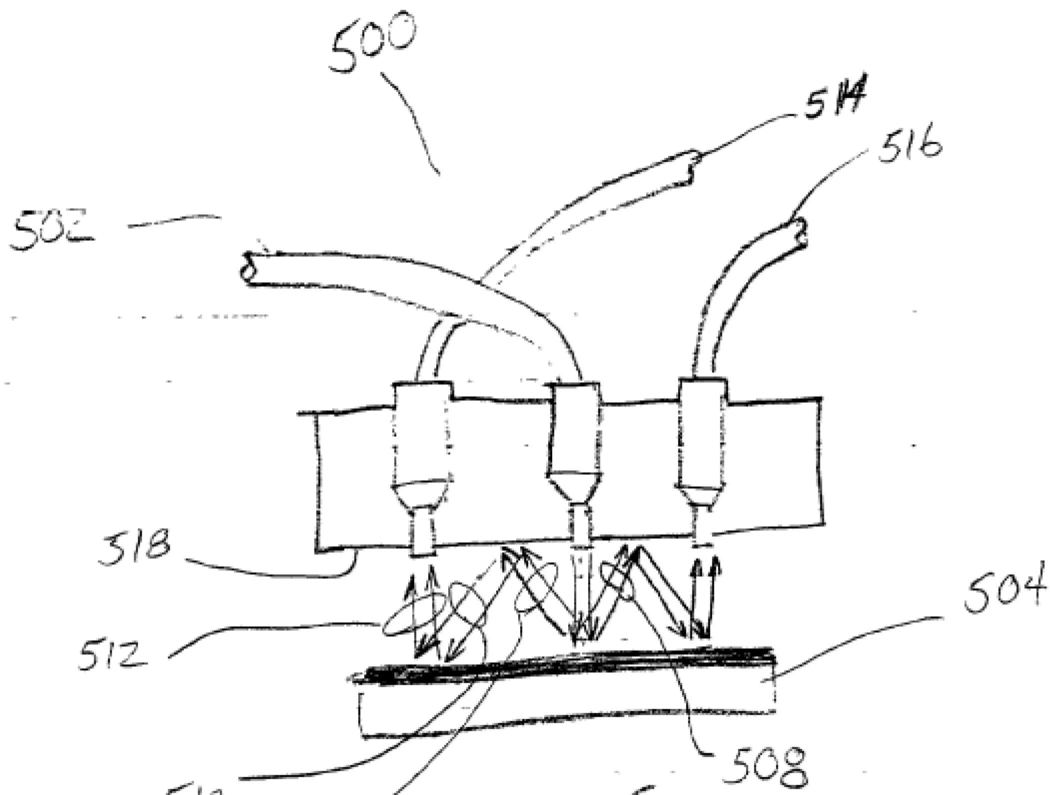


FIG. 5

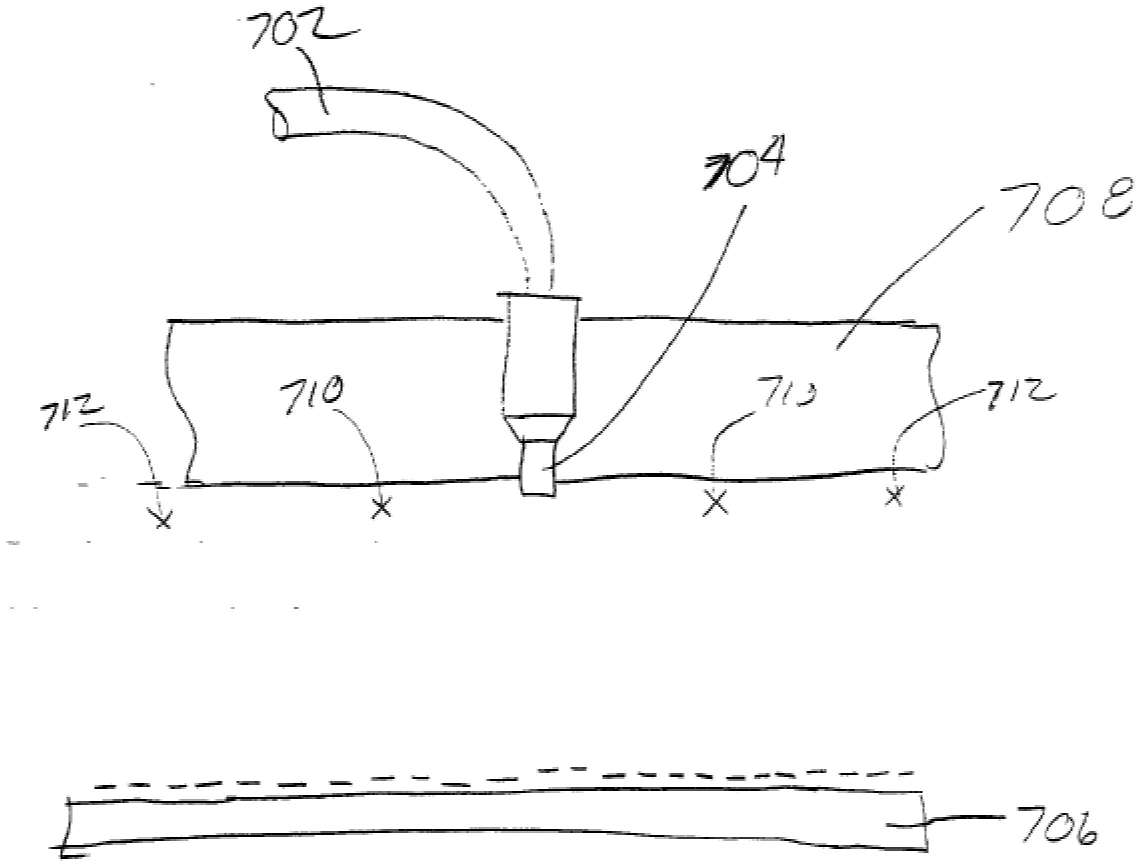


FIG. 7

1782. With respect to “at least one output fiber, each said output fiber defining an output optical axis and having an entrance end,” Tew ’520 Prov. discloses “An optical switch using an array of mirrors (608) to selectively reflect light from an input fiber (610) to either of a first output fiber (612) or a second output fiber (618).” See Tew ’520 Prov. at Abstract; *see also* Tew ’520 Prov. at 13:1-2 (“the light is received by a GRIN lens and enters a first output fiber 514”); *see also* Tew ’520 Prov. at FIGs. 5-6, 10 (FIG. 5 reproduced below).

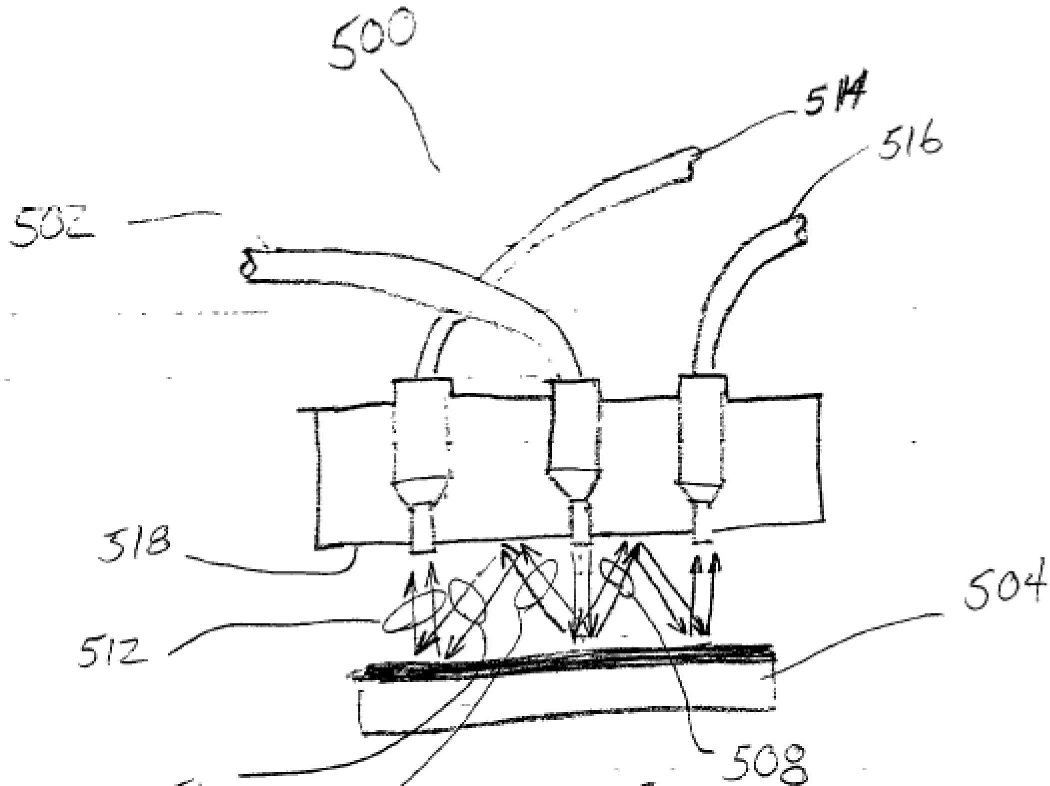


FIG. 5

1783. With respect to "a retro-reflective surface between said exit and entrance ends," Tew '520 Prov. discloses "FIG. 6 shows a side view of an alternate embodiment of the optical switch of FIG. 5. In FIG. 6, separate retro-reflectors 602 are used to reflect the light instead of the mirrored bottom surface of the holder block 518. Retro-reflectors 602 simplify the design of the holder block 604, but complicate the assembly and alignment process. The retro-reflector alternatively is one piece, with holes removed for the light to and from each fiber to pass through. To increase the separation between optical switches and to reduce the effect of stray light, some retro-reflectors 606 are designed not to reflect light. The same concept of anti-reflective regions is also applied to the one piece retro-reflector and the bottom mirrored surface

of the holding block." See Tew '520 Prov. at 7:7-20; *see also* Tew '520 Prov. at FIG. 6 (reproduced below).

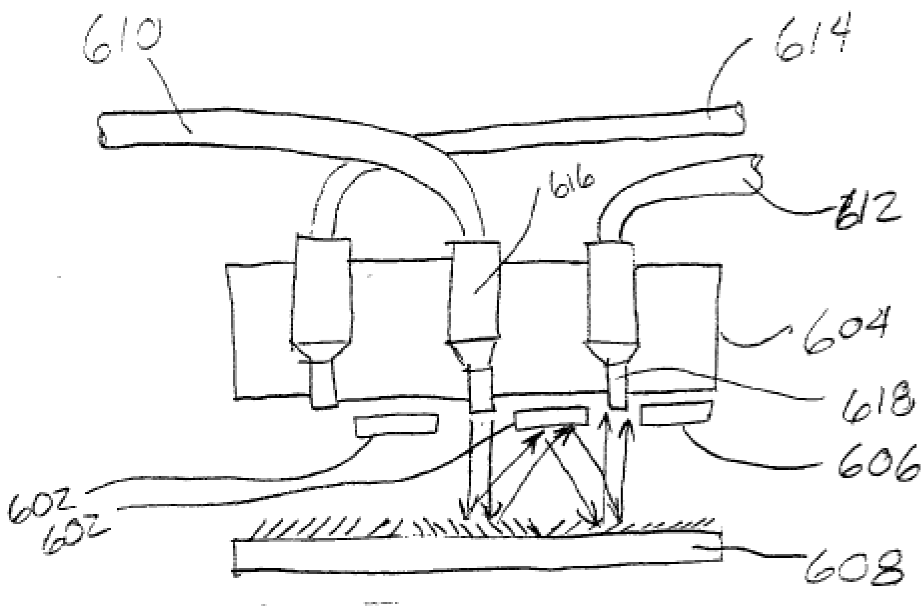


FIG. 6

1784. With respect to:

> a mirror array, said mirror array comprised of at least one mirror on each said input optical axis and said output optical axis, said mirrors on said input optical axes operable to deflect light from each input fiber to an intermediate spot on said retro-reflector, said mirrors on said output optical axes operable to reflect light from said intermediate spot of said retro-reflector to an associated output fiber sharing said output axis

Tew '520 Prov. discloses:

> An optical switch using an array of mirrors (608) to selectively reflect light from an input fiber (610) to either of a first output fiber (612) or a second output fiber (614). Each fiber is held in a ferrule (616) that aligns the fiber with a focusing device (618). The focusing device associated with the input fiber causes the beam of light to either collimate, diverge, or converge. The focusing device associated with each output fiber collects the beam of light for input into the output fibers. Light from the input fiber (610) strikes a first mirror, or group of mirrors, in the array (608) and is

> selectively deflected to a second mirror, or group of mirrors, associated with an output fiber (612, 614), by reflecting the beam of light from a retro-reflector (602) between the fibers. The second mirror receives the beam from the retro-reflector (602) and reflects it to the output fiber associated with the second mirror.

Tew ’520 Prov. at Abstract; *see also* Tew ’520 Prov. at FIG. 6 (reproduced below).

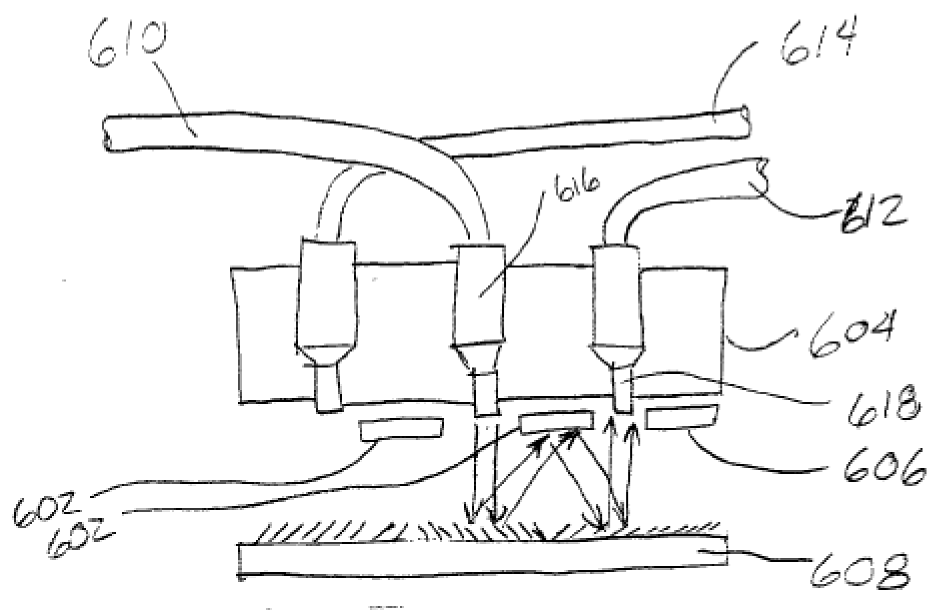


FIG. 6

1785. Accordingly, it is my understanding that Tew ’520 is prior art to the ’905 and ’906 Patents under at least pre-AIA 35 U.S.C. § 102(e).

(ii) *Tew ’520 Teaches Fiber Collimators*

1786. Tew ’520 discloses to a POSITA fiber collimators. For example, Tew ’520 discloses “[t]he GRIN lens collimates the light from the fiber.” Tew ’520 at 5:49-50. Additionally, Tew ’520 discloses “a light beam exiting fiber 702 through a collimating lens 704.” Tew ‘520 at 7:65-66; *see also* Tew ‘520 at FIGS. 3-7, 10 (FIG. 7 reproduced below).

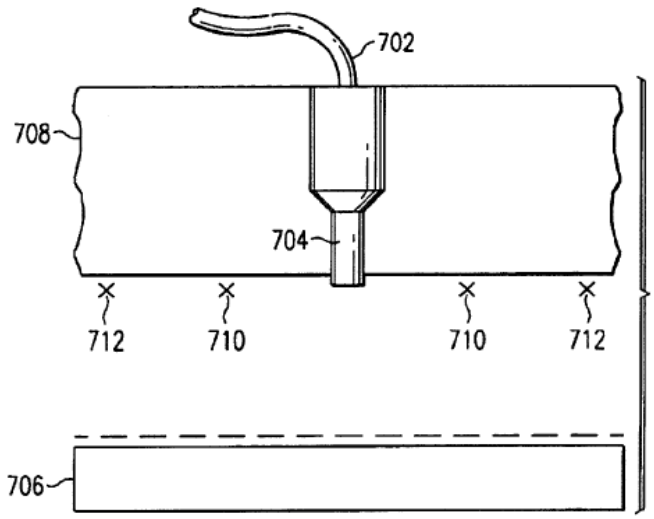


FIG. 7

1787. As another example, Tew '520 recognized that holding an optical fiber in a ferrule with a collimator lens, such as a self-focusing gradient index (GRIN) lens (what the Asserted Patents arguably identify as at least one example of "a fiber collimator" *see, e.g.*, '905 Patent at 9:34–38) "simplifies handling of the optical fibers." *See, e.g.*, Tew '520 at 5:45–50.

1788. Therefore, under Capella's apparent interpretation, Tew '520 discloses to a POSITA fiber collimators. Even if Tew '520 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(iii) *Tew '520 Teaches Add Ports and Drop Ports*

1789. Tew '520 discloses to a POSITA add ports and drop ports. For example, Tew '520 discloses an "optical switch comprising: a first input fiber; a second input fiber; a first output fiber; a second output fiber; a jumper fiber; and a mirror array. The mirror array is aligned with the input and output fibers to enable the mirror array to selectively deflect light from the first input fiber to either of the first and second output fibers, and from the second input fiber to the first output fiber and the jumper fiber. The jumper fiber positioned to transmit light from a first portion of the mirror array to a second portion of the mirror array. The second

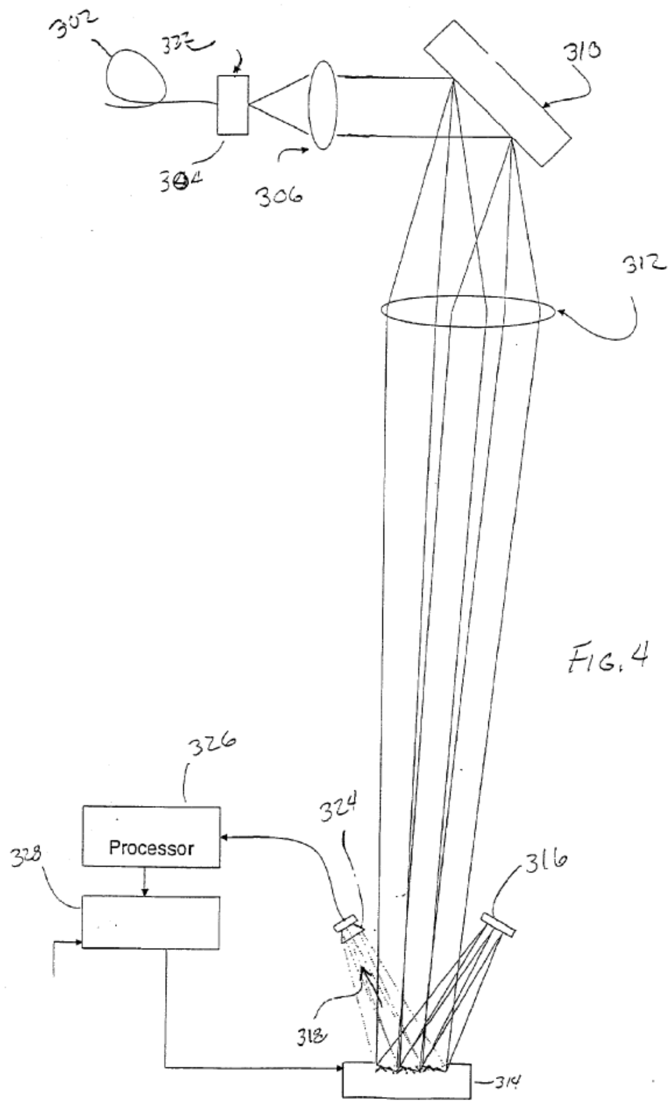
portion of said mirror array operable to deflect light from the jumper fiber to said second output fiber." Tew '520 at 2:23-36. A POSITA would understand the first and/or second input fiber can be an add port, and the first and/or second output fiber can be a drop port.

1790. Therefore, under Capella's apparent interpretation, Tew '520 discloses to a POSITA add ports and drop ports. Even if Tew '520 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

i) U.S. Patent Publication No. 2002/0081070 ("Tew '070")

1791. Tew '070 is directed to a "wavelength equalizer comprises an input waveguide (302), an output waveguide (322), a wavelength separation device (310), and a micromirror array (314)." Tew '070 at Abstract. Tew '070 also discloses a "controller 328 [that] determines which mirrors are rotated in the first and second directions so that a given signal has the proper signal strength at the output." Tew '070 at ¶45.

1792. As shown in Figure 4, reproduced below, a spectral beam can be incident upon a micromirror array that is controlled by a controller to manage the power of the spectral beam, and couple the spectral beam to an output waveguide.



Tew ‘070 at FIG. 4.

(i) *Tew ’070 Is Prior Art to the Asserted Claims*

1793. Tew ’070 claims priority to Provisional Application No. 60/250,520 filed on November 30, 2000, was filed on Nov. 13, 2001, and was published as 2002/0081070 on June 27, 2002.

1794. As noted above in Section III.D.1.a (Paragraph 47), it is my understanding that for a patent or patent publication to claim priority to a provisional application, the provisional

application must contain, for at least one claim recited in the patent or published patent application, a written description of the invention and the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable a person of ordinary skill in the art to practice the claimed invention. It is my opinion that these requirements are satisfied for Tew ’070 with respect to Provisional Application No. 60/250,520 (“Tew ’070 Prov.”). Accordingly, it is my understanding that Tew ’070 is entitled to a priority date of November 30, 2000.

1795. I understand that Tew ’070 is entitled to the priority date of Tew ’070 Prov. if at least one claim in Tew ’070 is supported by the disclosure of Tew ’070 Prov. At least Claim 1 of Tew ’070 is supported by the disclosure of Tew ’070 Prov. With respect to the preamble, which sets forth “[a] wavelength equalizer comprising,” Tew ’070 Prov. discloses a “wavelength equalizer comprises an input waveguide (302), an output waveguide (322), a wavelength separation device (310), and a micromirror array (314).” Tew ‘070 Prov. at Abstract.

1796. With respect to “an input waveguide for providing a beam of light along a first light path,” Tew ’070 Prov. discloses “[t]he method of equalizing a plurality of components of an optical input signal comprises: separating the components, directing each component to a sub-array of a micromirror array, positioning micromirrors in each sub-array such that ***micromirrors in a first position direct incident light*** to an output waveguide and micromirrors in a second position do not, and combining the sub-beams into an output beam of light.” Tew ‘070 at Abstract (emphasis added).

1797. With respect to “an output waveguide,” Tew ’070 Prov. discloses “[t]he method of equalizing a plurality of components of an optical input signal comprises: separating the

components, directing each component to a sub-array of a micromirror array, positioning micromirrors in each sub-array such that micromirrors in a first position direct incident light to ***an output waveguide and micromirrors in a second position do not, and combining the sub-beams into an output beam of light***." Tew '070 at Abstract (emphasis added). Tew '070 Prov. also discloses "[t]he first position directing light in the sub-beam to the output waveguide, and the second position excluding the light in the sub-beam from the output waveguide." Tew '070 Prov. at 2:8-10."

1798. With respect to "a wavelength separation device for dividing said beam of light into sub-beams," Tew '070 Prov. discloses that a "[w]avelength separation device 310 can be any type of device, such as a diffraction grating, prism, or other optical component. The grating spatially separates each wavelength carried by the optical fiber 302." Tew '070 Prov. at 10:11-12.

1799. With respect to:

> a micromirror array in the path of said sub-beam, a sub-array of said micromirrors in said micromirror array operable between a first and second position, said first position directing light in said sub-beam to said output fiber, and said second position excluding said light in said sub-beam from said output fiber

Tew '070 Prov. discloses:

> A wavelength equalizer and method. The wavelength equalizer comprises an input waveguide (302), an output waveguide (322), a wavelength separation device (310), and a micromirror array (314). The wavelength separation device (310) divides the input beam of light into sub-beams. A first sub-array of the micromirrors in the micromirror array (314) are operable between a first and second position. The first position directing light in the sub-beam to the output waveguide (322), and the second position excluding the light in the sub-beam from the output waveguide (322). The method of equalizing a plurality of components of an optical input signal comprises: separating the components, directing each component to a sub-array of a micromirror array, positioning micromirrors in each sub-array such that micromirrors in a first

> position direct incident light to an output waveguide and micromirrors in a second position do not, and combining the sub-beams into an output beam of light.

Tew ’070 Prov. at Abstract.

1800. Accordingly, it is my understanding that Tew ’070 is prior art to the ’905 and ’906 Patents under at least pre-AIA 35 U.S.C. § 102(e).

(ii) *Tew ’070 Teaches Managing Power Levels*

1801. Tew ’070 discloses to a POSITA managing or maintaining power levels. For example, Tew ’070 discloses “[t]he controller determines which mirrors are rotated in the first and second directions so that a given signal has the proper signal strength at the output.” Tew ‘070 at ¶70. Tew ’070 also discloses “[a] micromirror array 314, however, is an optimal device since it provides precise adjustment of the power levels, reliable operation, and excellent isolation between the first and second mirror positions.” Tew ‘070 at ¶35; *see also* Tew ‘070 at ¶52 (“mirrors typically are positioned to equalize the power between each sub-beam traveling through the input and output fibers, but the various sub-beams may be adjusted to have other power levels”).

1802. Tew ’070 discloses to a POSITA managing or maintaining power levels. Even if Tew ’070 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(iii) *Tew ’070 Maintaining a Predetermined Coupling of Each Reflected Spectral Channel Into One Of Said Fiber Collimator Output Ports*

1803. Tew ’070 discloses to a POSITA maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports by adjusting micromirrors. For example, Tew ’070 discloses “[t]he controller determines which mirrors are

rotated in the first and second directions so that a given signal has the proper signal strength at the output." Tew '070 at ¶70; *see also* Tew '070 at ¶37 (that a POSITA would understand that a predetermined coupling can be achieved using mirrors). Tew '070 also discloses using a detector controller to determine the strength of a signal, which a POSITA would understand can be used to predetermine the coupling of a signal to an output port. "[T]he detector controller 328 can determine the input and output strengths of the signal corresponding to that sub-array. The controller 328 determines which mirrors are rotated in the first and second directions so that a given signal has the proper signal strength at the output." Tew '070 at ¶45.

1804. Therefore, under Capella's apparent interpretation, Tew '070 discloses to a POSITA maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports by adjusting micromirrors. Even if Tew '070 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(iv) *Tew '070 Teaches Not Sending Signals Through a Circulator*

1805. Tew '070 discloses to a POSITA that signals do not have to be transmitted through a circulator. For example, Tew '070 discloses "[a]ny light separation device can be used in place of the circulator 304 shown in FIG. 4." Tew '070 at ¶39. Additionally, A POSITA would avoid using a circulator as Tew '070 discloses that the embodiment of Figure 7 (reproduced below) "avoids the use of a circulator, which is an expensive component." Tew '070 at ¶67*; see also* Tew '070 at FIG. 7.

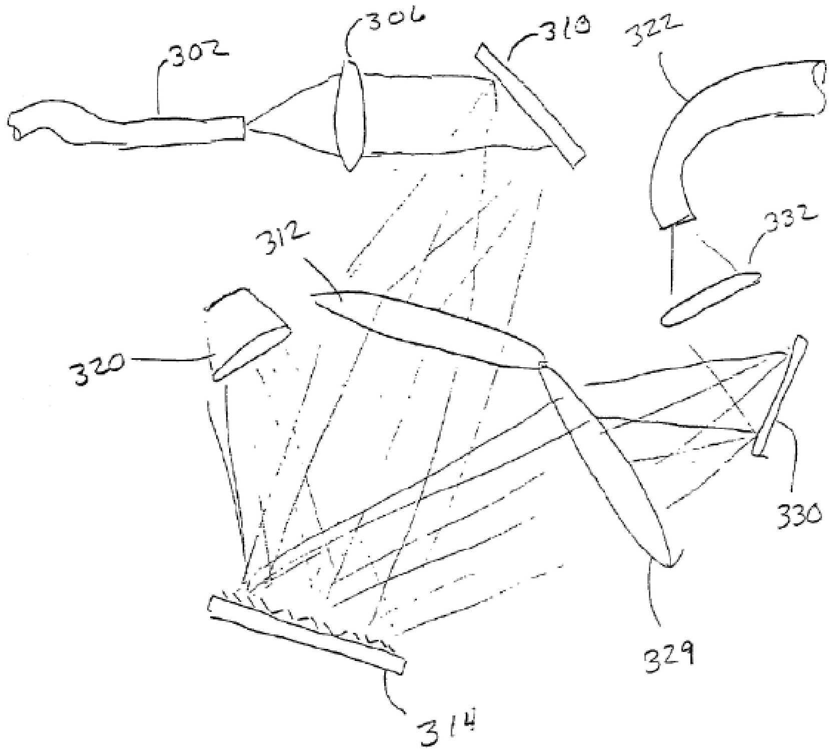


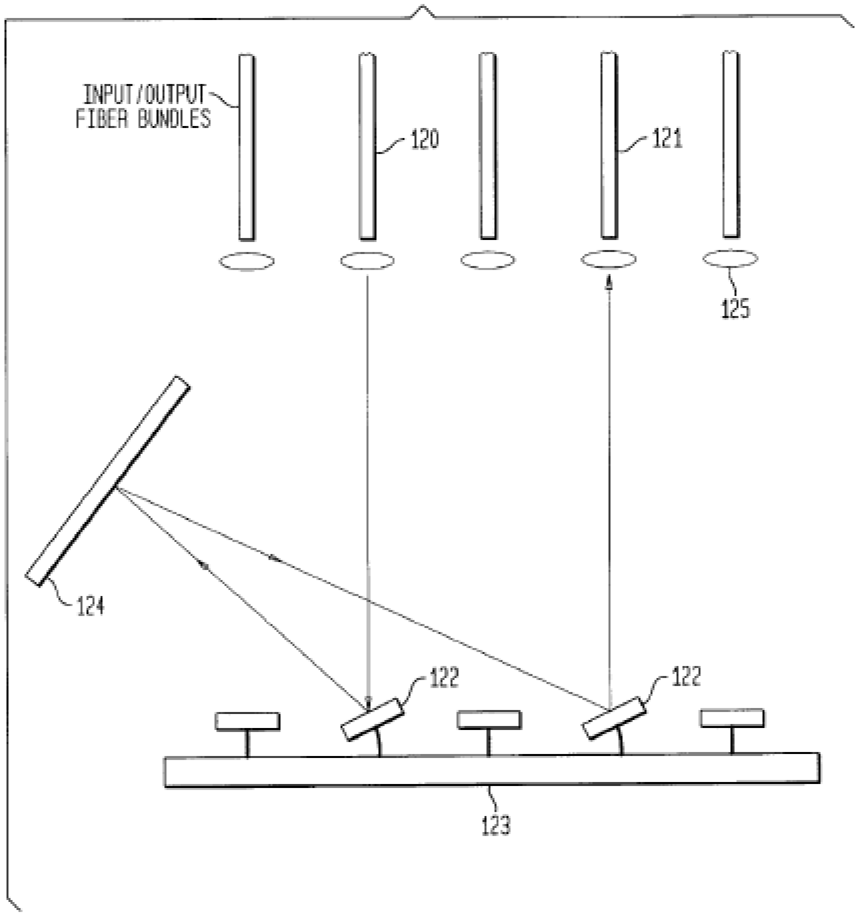
FIG. 7

1806. Therefore, under Capella's apparent interpretation, Tew '070 discloses to a POSITA that signals do not have to be transmitted through a circulator. Even if Tew '070 does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

j) U.S. Patent No. 6,442,307 ("Carr")

1807. Carr is directed to a MEMs mirror device. Particularly, Carr discloses "an important application of optical MEMs mirrors as controllable mirror arrays for optical Signal routing . . . optical signals from the input fibers 120 are incident on aligned mirrors 122. The mirrors 122, with the aid of a fixed auxiliary mirror 124 and appropriate imaging lenses 125, are electrically controlled to reflect the incident optical signals to respective output fibers 121." Carr at 1:58-67; *see also* Carr at Fig. 1B (reproduced below).

FIG. 1B



(i) *Carr Is Prior Art to the Asserted Claims*

1808. Carr was filed on November 3, 2000 and issued on August 27, 2002.

1809. Accordingly, it is my understanding that Carr is prior art to the ’905 and ’906 Patents under at least pre-AIA 35 U.S.C. § 102(e).

(ii) *Carr Teaches a Predetermined Coupling*

1810. Carr discloses to a POSITA maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports by adjusting micromirrors. For example, Carr discloses “Fine control of the mirror orientation permitted by the accurate spacing and alignment of solder bonding assembly permits fine control of the

degree of attenuation. Carr at 11:11-33. A POSITA would be able to recognize that power levels could be adjusted by, for example, (1) the number of mirrors used, (2) the angle of the mirrors, and (3) the location of the mirrors. *See, e.g.*, Carr at 11:11–12:50.

1811. Carr discloses to a POSITA maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports by adjusting micromirrors. Even if Carr does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

k) U.S. Patent No. 6,496,291 ("Raj")

1812. Raj is directed to an optical serial link with an "elliptical reflector 22 [that] may be a reflective ellipsoid or conic section placed on one side of the optical block 25 . . . the reflector 22 may be adjustable for precise alignment of the reflector 22 with the dispersive element 52 and the fiber arrays 28 and 60." Raj at 3:56-67; *see also* Raj at FIG. 3 (reproduced below).

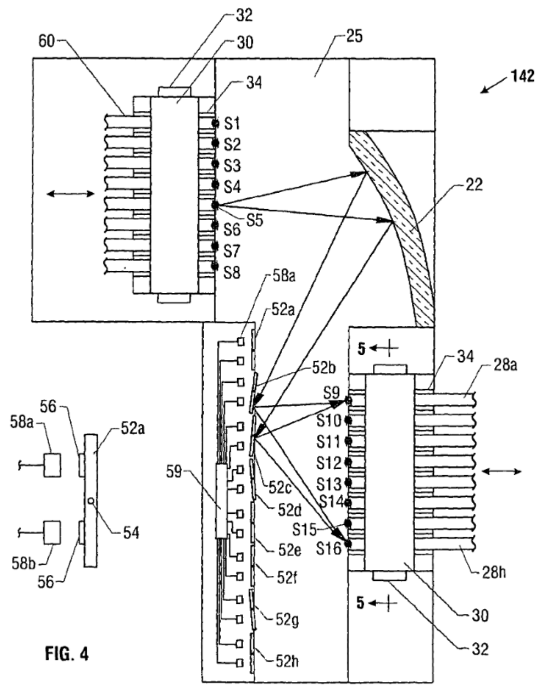


FIG. 4

FIG. 3

(i) *Raj Is Prior Art to the Asserted Claims*

1813. Raj was filed on October 17, 2000 and issued on December 17, 2002.

1814. Accordingly, it is my understanding that Raj is prior art to the ’905 and ’906 Patents under at least pre-AIA 35 U.S.C. § 102(e).

(ii) *Raj Teaches Collimator-Alignment mirrors*

1815. Under Capella’s apparent interpretation, Raj discloses to a POSITA collimator-alignment mirrors. For example, Raj discloses “An optical serial link comprising: a first and a second optical fiber array, an elliptical reflector optically aligned with said arrays, a dispersive element aligned with said elliptical reflector to reflect a light beam from the first to the second optical fiber array; and an optical transceiver optically coupled to one of said arrays. Raj at Claim 1; *see also* Raj at FIGS. 3-4 (reproduced below).

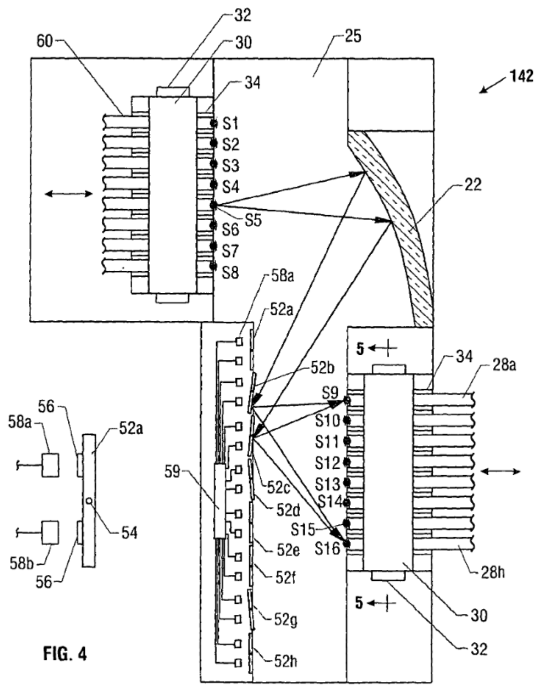


FIG. 3

1816. Raj also discloses that "the ultimate disposition of each channel on each fiber 60 may be controlled by the MEMS element 52 to specifically direct or route each input channel to a particular output fiber 28. This arrangement allows shifting of a group of wavelengths on one set of channels to another set of channels while adding or dropping one or more channels in a selective manner. A relatively high precision, compact arrangement is possible in some embodiments." Raj at 4:45-53. To the extent that "fiber collimator" port requires a collimator and a port in a single package, a POSITA would have known to combine a collimator and a port to make a "fiber collimator" port in a single package.

1817. Therefore, under Capella's apparent interpretation, Raj discloses to a POSITA collimator alignment mirrors. Even if Raj does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

l) U.S. Patent No. 6,583,934 ("Kramer")

1818. Kramer is directed to "[a]n optical wavelength selection apparatus containing a surface-relief transmission diffraction grating, a collimating lens for collimating a beam incident to the diffraction grating, and a focusing lens for focusing the beams diffracted by the diffraction grating." Kramer at Abstract; *see also* Kramer at FIG. 10A. Kramer discloses a "collimating/focusing lens assembly 87 [that] receives the collimated diffracted λ1, λ2, and λ3 wavelength beams 190 from the dual pass grating element 150 and focuses these beams onto the surface of the output fiber array 184." Kramer at 19:53-57.

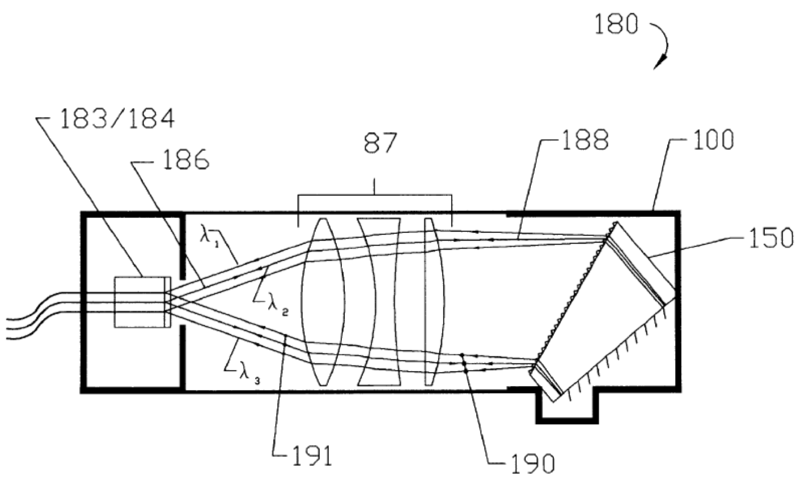


FIGURE 10A

(i) *Kramer Is Prior Art to the Asserted Claims*

1819. Kramer claims priority to U.S. Patent Application No. 09/761,509 filed on January 16, 2001, was filed on February 9, 2001, was published as 2003/0076590 on April 24, 2003, and issued on June 24, 2003.

1820. Accordingly, it is my understanding that Kramer is prior art to the '905 and '906 Patents under at least pre-AIA 35 U.S.C. § 102(e).

(ii) *Kramer Teaches Fiber Collimators*

1821. Kramer discloses to a POSITA fiber collimators. For example, Kramer discloses "[a]n optical wavelength selection apparatus containing a surface-relief transmission diffraction grating, a collimating lens for collimating a beam incident to the diffraction grating, and a focusing lens for focusing the beams diffracted by the diffraction grating." Kramer at Abstract; *see also* Kramer at 34:20-28; *see also* Kramer at 13:31-63 (discussing a collimating lens assembly receiving a ray bundle from the end of an input fiber); *see also* Kramer at FIGS. 10A-10B (reproduced below).

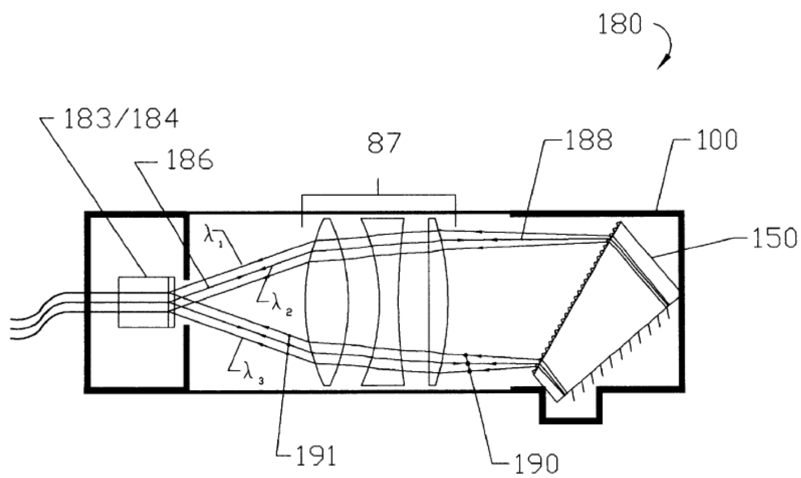


FIGURE 10A

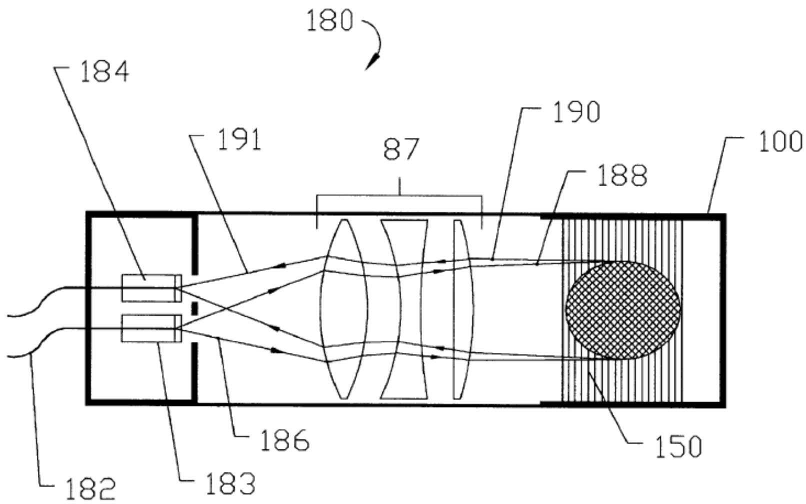


FIGURE 10B

1822. Therefore, under Capella's apparent interpretation, Kramer discloses to a POSITA fiber collimators. Even if Kramer does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(iii) *Kramer Teaches Not Sending Signals Through a Circulator*

1823. Kramer discloses to a POSITA that signals do not have to be transmitted through a circulator. Kramer discloses "[o]ptical circulator devices are expensive and add optical insertion loss to the ADWM device." Kramer at 33:62-63. Kramer also discloses "the incorporation of the four parallel beam paths 352, 354, 356, and 358 into device 270 enables this add/drop device to function without the need for optical circulator devices and enables the device 350 to simultaneously switch a λ1 wavelength channel signal from the input beam path 352 to the drop beam path 358 while switching a λ1 wavelength channel signal from the add beam path 356 to the output beam path 354." Kramer at 34:20-28; see also Kramer at 33:56-34:2

1824. Therefore, Kramer discloses to a POSITA that signals do not have to be transmitted through a circulator. Even if Kramer does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

m) Yuan & Riza, General Formula for Coupling-loss Characterization of Single-mode Fiber Collimators by Use of Gradient-index Rod Lenses ("Yuan")

1825. Yuan is directed to "[a] general formula for determining the coupling loss between two single-mode fiber collimators with the simultaneous existence of separation, lateral offset and angular tilt misalignments, and spot-size mis- match is theoretically derived by use of the Gaussian field approximation." Yuan at Abstract; *see also* Yuan at FIG. 1 (reproduced below).

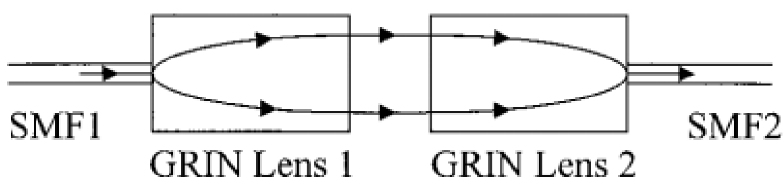


Fig. 1. Fiber coupling system using two quarter-pitch SMF colli- mators.

(i) *Yuan Is Prior Art to the Asserted Claims*

1826. Yuan was published as "General Formula for Coupling-loss Characterization of Single-mode Fiber Collimators by Use of Gradient-index Rod Lenses" on May 20, 1999.

1827. Accordingly, it is my understanding that Yuan is prior art to the '905 and '906 Patents under at least pre-AIA 35 U.S.C. § 102(a).

(ii) *Yuan Teaches Fiber Collimators*

1828. Yuan discloses to a POSITA fiber collimators. For example, Yuan discloses "Figure 1 shows the fiber coupling system with two SMF collimators. GRIN lens 1 is a

transmitting lens, and GRIN lens 2 is a receiving lens or focusing lens." Yuan at 3215t; *see also* Yuan at 3214:

> Free-space-based fiber-optic components such as isolators, circulators, attenuators, switches, and wavelength-division multiplexers/demultiplexers have become key devices for optical fiber communications, optical fiber sensing, and radio-frequency photonics. In these free-space-based fiber-optic components, single-mode-fiber (SMF) or multimode-fiber pigtailed fiber collimators have been widely used. This is so because the coupling between two fiber collimators has a large allowable separation distance with a low loss that is critical for a practical free-space interconnected fiber-optic module or subsystem.

See also Yuan at FIG. 1 (reproduced below).

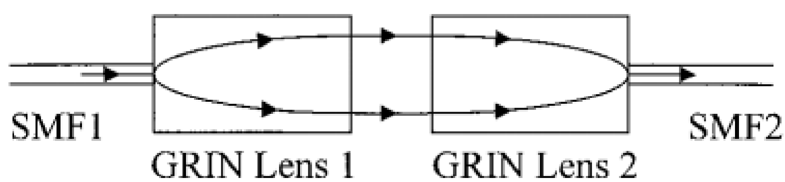


Fig. 1. Fiber coupling system using two quarter-pitch SMF collimators.

1829. Therefore, under Capella's apparent interpretation, Yuan discloses to a POSITA fiber collimators. Even if Yuan does not do so, however, these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

2. <u>The Differences Between the Claimed Invention and the Prior Art</u>

1830. The following analysis provides my opinions regarding the differences between the claimed invention and the prior art.

a) Obviousness Based on Tew '640

1831. In my opinion, before accounting for secondary considerations, a POSITA would find the Asserted Claims obvious in view of Tew '640 and the foregoing, alone or in combination:

- The knowledge of a POSITA;
- Smith;
- Solgaard;
- Lalonde;
- Sparks
- Rose;
- Bouevitch;
- Tew ’520;
- Tew ’070;
- Carr;
- Raj;
- Kramer; and
- Yuan.

I analyzed the scope and content of Tew ’640 above in Section IX.1.a, and I incorporate that analysis by reference. Below, I have selected certain example limitations from the Asserted Claims and explained why it would have been obvious to combine Tew ’640 (alone or in combination with the common knowledge of a POSITA and/or other prior art) to include these limitations. However, to the extent any limitations are absent from Tew ’640 that are not specifically addressed below, such limitations would have been within the common knowledge of a POSITA, and POSITA would have been motivated to combine Tew ’640 (alone or in combination with the common knowledge of a POSITA and/or other prior art) with the other prior art references discussed throughout this report to include those limitations.

(i) *Maintaining power levels at predetermined values and maintaining predetermined coupling*

1832. To the extent Tew ’640 did not teach maintaining power levels at predetermined values and maintaining predetermined coupling, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
’905 Patent	26	“. . . wherein said servo-control assembly maintains said power levels at predetermined values.”
’906 Patent	69	“. . . a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports.”
’906 Patent	71	“. . . wherein said servo-control assembly maintains said power levels at a predetermined value.”
’906 Patent	89-e	“. . . a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports.”
’906 Patent	91	“. . . wherein said servo-control assembly maintains said power levels at a predetermined value.”
’906 Patent	116	“. . . a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output port.”
’906 Patent	134	“. . . the step of providing feedback control of said beam-deflecting elements to maintain a predetermining coupling of each spectral channel directed into one of said output ports.”

Patent	**Claim(s)**	**Limitations**
’906 Patent	135	“. . . the step of maintaining power levels of said spectral channels directed into said output ports at a predetermining value.”

1833. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add maintaining power levels at predetermined values to Tew ’640 (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Tew ’640 (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1834. A POSITA also would have combined other prior art references with Tew ’640, incorporating these limitations into Tew ’640. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.i, Tew ’070 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference.

1835. A POSITA would have been motivated to combine Tew ’640 (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Smith, Sparks, Rose, Tew ’070, and/or Smith to include these limitations for at least the following reasons. Maintaining power levels of the spectral channels coupled into the output ports at a predetermined value was well-known in the prior art. For example, Smith discloses that “all

wavelength channels on [the] output fiber[s] should have the same intensity so that optical receivers and other components located downstream will detect wavelength channels of equal intensity." Smith at 9:59-63. It would have been obvious for someone skilled in the art to maintain power levels of the spectral channels at a predetermined value in a cross-connect or ROADM because of many well-known benefits conferred. As Smith explains, such power equalization at a predetermined value is desired in order to, for example, satisfy the dynamic range restrictions of downstream receivers and to satisfy the amplifier input limits of downstream receivers. Smith at 10:47-55. The prior art recognized that, although one could use "optical amplifiers" to "amplify optical signals and compensate loss," "the entire WDM signal and their gain spectrum is typically not flat[,]" which would motivate a person of ordinary skill in the art to combine or modify the prior art to "maintain the power levels of different signals", including to maintain them such that they are "the same or at least in predetermined ratios." *See, e.g.*, Smith at 6:18–23. The prior art also recognized the importance of dynamically controlling power levels and implementing feedback control to, for example, "maintain a significant degree of uniformity of power levels across the WDM spectrum," and to account for "internal variations of optical characteristics and misalignments" and "mechanical stress," (*see, e.g.*, *id.* at 6:24–50; *see also, e.g.*, Rose at 11:37–41; *see also* Rose at 11:60-12:8). The prior art also recognized that power levels could be adjusted by, for example, (1) the number of mirrors used, (2) the angle of the mirrors, and (3) the location of the mirrors (Tew '070, ¶ 37; *see also, e.g.*, Smith at 6:55–57, 7:32–44, 7:49–52), and a POSITA would have been motivated to combine or modify the prior art to use any or all of these techniques. The prior art also recognized the importance of using a servo control system to achieve a predetermined output power by controlling the misalignment, or efficiency, of the optical beam path. *See* Sparks at 3:22-27; *see*

also Sparks at Abstract; Sparks at 2:20-25; Sparks at 3:3-9; Sparks at 3:14-21; Sparks at 3:37-43; Sparks at 4:38-40 ("a closed-loop servo control system is employed. The control system is normally used to provide high optical coupling efficiency").

(ii) *Managing power levels of first and second spectral channels*

1836. To the extent Tew '640 did not teach managing power levels of first and second spectral channels, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'905 Patent	44	". . . a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels."

1837. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add managing power levels of first and second spectral channels to Tew '640 (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Tew '640 (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1838. A POSITA also would have combined other prior art references with Tew '640, incorporating these limitations into Tew '640. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith

taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.i, Tew '070 taught these limitations, and I incorporate that analysis by reference.

1839. A POSITA would have been motivated to combine Tew '640 (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Rose, Smith, and/or Tew '070 to include these limitations for at least the following reasons. Maintaining power levels of the spectral channels coupled into the output ports at a predetermined value was well-known in the prior art. For example, Smith discloses that "all wavelength channels on [the] output fiber[s] should have the same intensity so that optical receivers and other components located downstream will detect wavelength channels of equal intensity." Smith at 9:59-63. It would have been obvious for someone skilled in the art to maintain power levels of the spectral channels at a predetermined value in a cross-connect or ROADM because of many well-known benefits conferred. As Smith explains, such power equalization at a predetermined value is desired in order to, for example, satisfy the dynamic range restrictions of downstream receivers and to satisfy the amplifier input limits of downstream receivers. Smith at 10:47-55. The prior art recognized that, although one could use "optical amplifiers" to "amplify optical signals and compensate loss," "the entire WDM signal and their gain spectrum is typically not flat[,]" which would motivate a person of ordinary skill in the art to combine or modify the prior art to "maintain the power levels of different signals", including to maintain them such that they are "the same or at least in predetermined ratios." *See, e.g.*, Smith at 6:18–23. The prior art also recognized the importance of dynamically controlling power levels and implementing feedback control to, for example, "maintain a significant degree of uniformity of power levels across the WDM spectrum," and to account for "internal

variations of optical characteristics and misalignments" and "mechanical stress," (*see, e.g.*, *id.* at 6:24–50; *see also, e.g.*, Rose at 11:37–41; *see also* Rose at 11:60-12:8). The prior art also recognized that power levels could be adjusted by, for example, (1) the number of mirrors used, (2) the angle of the mirrors, and (3) the location of the mirrors (Tew '070, ¶ 37; *see also, e.g.*, Smith at 6:55–57, 7:32–44, 7:49–52), and a POSITA would have been motivated to combine or modify the prior art to use any or all of these techniques. The prior art also recognized the importance of using a servo control system to achieve a predetermined output power by controlling the misalignment, or efficiency, of the optical beam path. *See* Sparks at 3:22-27; *see also* Sparks at Abstract; Sparks at 2:20-25; Sparks at 3:3-9; Sparks at 3:14-21; Sparks at 3:37-43; Sparks at 4:38-40 ("a closed-loop servo control system is employed. The control system is normally used to provide high optical coupling efficiency").

(iii) *Controlling coupling efficiency*

1840. To the extent Tew '640 did not teach controlling coupling efficiency, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'905 Patent	45	". . . wherein the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port."

1841. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add controlling coupling efficiency to Tew '640 (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to

add their common knowledge to Tew '640 (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1842. A POSITA also would have combined other prior art references with Tew '640, incorporating these limitations into Tew '640. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.f, Bouevitch taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.i, Tew '070 taught these limitations, and I incorporate that analysis by reference.

1843. A POSITA would have been motivated to combine Tew '640 (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Rose, Smith, Bouevitch, and/or Tew '070 to include these limitations for at least the following reasons. Maintaining power levels of the spectral channels coupled into the output ports at a predetermined value was well-known in the prior art. For example, Smith discloses that "all wavelength channels on [the] output fiber[s] should have the same intensity so that optical receivers and other components located downstream will detect wavelength channels of equal intensity." Smith at 9:59-63. It would have been obvious for someone skilled in the art to maintain power levels of the spectral channels at a predetermined value in a cross-connect or ROADM because of many well-known benefits conferred. As Smith explains, such power equalization at a predetermined value is desired in order to, for example, satisfy the dynamic range restrictions of downstream receivers and to satisfy the amplifier input limits of

downstream receivers. Smith at 10:47-55. The prior art recognized that, although one could use "optical amplifiers" to "amplify optical signals and compensate loss," "the entire WDM signal and their gain spectrum is typically not flat[,]" which would motivate a person of ordinary skill in the art to combine or modify the prior art to "maintain the power levels of different signals", including to maintain them such that they are "the same or at least in predetermined ratios." *See, e.g.*, Smith at 6:18–23. The prior art also recognized the importance of dynamically controlling power levels and implementing feedback control to, for example, "maintain a significant degree of uniformity of power levels across the WDM spectrum," and to account for "internal variations of optical characteristics and misalignments" and "mechanical stress," (*see, e.g.*, *id.* at 6:24–50; *see also, e.g.*, Rose at 11:37–41; *see also* Rose at 11:60-12:8). The prior art also recognized that power levels could be adjusted by, for example, (1) the number of mirrors used, (2) the angle of the mirrors, and (3) the location of the mirrors (Tew '070, ¶ 37; *see also, e.g.*, Smith at 6:55–57, 7:32–44, 7:49–52), and a POSITA would have been motivated to combine or modify the prior art to use any or all of these techniques. The prior art also recognized the importance of using a servo control system to achieve a predetermined output power by controlling the misalignment, or efficiency, of the optical beam path. *See* Sparks at 3:22-27; *see also* Sparks at Abstract; Sparks at 2:20-25; Sparks at 3:3-9; Sparks at 3:14-21; Sparks at 3:37-43; Sparks at 4:38-40 ("a closed-loop servo control system is employed. The control system is normally used to provide high optical coupling efficiency"). As another example, Bouevitch discloses displacement of input and output light beams to affect coupling efficiency. "The lateral displacement of the input and modified output beams of light (i.e., as opposed to angular displacement) allows for highly efficient coupling between a plurality of input/output waveguides." Bouevitch at 7:60-64.

(iv) *Pivoting about two axes*

1844. To the extent Tew '640 did not teach pivoting about two axes, this limitation would have been within the common knowledge of a POSITA and were disclosed in the prior art. This specific limitation is found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	68-d	". . . said channel micromirrors being pivotal about two axes . . . ."
'906 Patent	115-e	". . . said channel micromirrors being pivotal about two axes . . . ."
'906 Patent	133-d	"dynamically and continuously controlling said beam-deflecting elements in two dimensions . . . ."

1845. As an initial matter, this limitation was within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add pivoting about two axes to Tew '640 (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Tew '640 (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1846. A POSITA also would have combined other prior art references with Tew '640, incorporating these limitations into Tew '640. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference.

1847. A POSITA would have been motivated to combine Tew ’640 (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Lalonde, and/or Smith to include these limitations for at least the following reasons. The prior art recognized that it was “desirable to integrate” into optical networks systems that utilized arrays of mirrors that were tiltable about two axes, at least so as to dynamically control power levels. *See, e.g.*, Smith at 6:51–61 (describing U.S. Patent No. 6,263,123 to Bishop et al.). Lalonde also describes `3-D MEMS` devices have emerged as the photonic switch technology of choice for large fabric switches. 3-D MEMS is a term used by the Applicant for a mirror mounted on a frame that can be ***rotated along two axes***, giving it four degrees of freedom. The 3-D MEMS devices are arranged preferably in a matrix, which comprises besides the mirrors a control system for positioning the mirrors independently.” *See* Lalonde at 2:30-37 (emphasis added); *see also id.* at 3:16-18, 4:61-64, 5:34-57, 6:9-35, 6:54-66, 7:13-42, 7:65-8:14, 8:46-60, Figs. 3A-4B. A would have not only been motivated to combine or modify the prior art so as to dynamically control power levels and implement feedback control but would have been specifically been motivated to combine or modify the prior art to incorporate arrays of mirrors tiltable about two axes to do so. Sparks also discloses light that can be reflected off a movable mirror which precisely directs the beam in two axes. Sparks at 4:15-23; *see also* Sparks at FIG. 1. A POSITA would have been motivated to modify Tew ’640 because it was within such person’s knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references.

(v) *A servo-control assembly in communication with channel micromirrors and fiber collimator ports*

1848. To the extent Tew ’640 did not teach a servo-control assembly in communication with channel micromirrors and fiber collimator ports, these limitations would have been within

the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'905 Patent	25	". . . a servo-control assembly . . . ."
'905 Patent	26	". . . wherein said servo-control assembly maintains said power levels at predetermined values."
'906 Patent	69	". . . a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports . . . ."
'906 Patent	70	". . . wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."
'906 Patent	90	". . . wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."
'906 Patent	116	". . . a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports."
'906 Patent	117	". . . wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."
'906 Patent	134	". . . the step of providing feedback control of said beam-deflecting elements to maintain a predetermining coupling of each spectral channel directed into one of said output ports."

1849. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add a servo-control assembly in communication with channel micromirrors and fiber collimator ports to Tew '640 (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Tew '640 (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1850. A POSITA also would have combined other prior art references with Tew '640, incorporating these limitations into Tew '640. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference.

1851. A POSITA would have been motivated to combine Solgaard (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Rose, Smith, and/or Lalonde to include these limitations for at least the following reasons. A POSITA would have been motivated to add a servo-control assembly to Solgaard to use feedback power measurements to control the beam-deflecting elements. It is well-recognized in the prior art to provide optical feedback control of micromirrors and other beam-deflecting elements in an optical switching device such as a ROADM or optical cross-connect. Combining

such references would have been nothing more than using known techniques of spectral monitoring, feedback, and control processing in optical interconnects to provide a servo-control assembly to similar optical interconnects in the same ways and for the same purposes. Even the Asserted Patents recognize that a POSITA would have known "how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application." '905 Patent at 12:33-36. The prior art also recognized the importance of using a servo control system to achieve a predetermined output power by controlling the misalignment, or efficiency, of the optical beam path. *See* Sparks at 3:22-27; *see also* Sparks at Abstract; *see also* Sparks at 2:20-25; *see also* Sparks at 3:3-9; *see also* Sparks at 3:14-21; *see also* Sparks at 3:37-43; *see also* Sparks at 4:38-40 ("a closed-loop servo control system is employed. The control system is normally used to provide high optical coupling efficiency"). Furthermore, the components used for performing the functions of spectral monitoring and feedback servo-control of the mirrors are the same or analogous to the components used for channel switching functions. It would have been obvious for a POSITA to try to use these common components for both the functions of optical channel switching and for power control in a feedback loop, as there would have been a reasonable expectation of success and a common sense advantage in reducing cost and size of the system by reducing the number of components needed to perform both functions.

(vi) *Quarter-wave plate*

1852. To the extent Tew '640 did not teach a quarter-wave plate, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**

Patent	**Claim(s)**	**Limitations**
’906 Patent	85	“. . . a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors.”
’906 Patent	125	“. . . a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors.”

1853. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add a quarter-wave plate to Tew ’640 (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Tew ’640 (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1854. A POSITA also would have combined other prior art references with Tew ’640, incorporating these limitations into Tew ’640. For example, as discussed above in Section IX.1.c, Solgaard taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.f, Bouevitch taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference.

1855. A POSITA would have been motivated to combine Tew ’640 (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Solgaard, Rose, Bouevitch, and/or Smith to include these limitations for at least the following reasons.

The prior art also recognized that it was "well understood by those in the art" that "wave plates" (such as quarter- or half-wave plates) could be inserted, for example, "so as to substantially eliminate polarization dependence within the switch." *See, e.g.*, Smith at 5:39–42; *see also, e.g.*, Solgaard at 8:18–20; Bouevitch at 5:49–60, 7:23–44; Rose at 19:56-59. A POSITA would have been motivated to modify Lalonde to include wave plates, such as quarter- or half-wave plates to, for example, substantially eliminate polarization dependence or sensitivity. As another example, Bouevitch discloses a quarter wave plate interposed between a birefringent element and a reflector on a MEMs array. "A beam of light having a predetermined polarization state launched from port 102 a is dispersed into sub-beams and is passed through a birefringent element 156 and quarter waveplate 157. The birefringent element 156 is arranged not to affect the polarization of the sub-beam of light. After passing through the quarter waveplate 157, the beam of light becomes circularly polarized and is incident on a predetermined reflector of the MEMS array 155. The reflector reflects the sub-beam of light incident thereon back to the quarter waveplate." Bouevitch at 7:23-35; *see also* Bouevitch at FIG. 5 (element 157).

(vii) *Optical sensors*

1856. To the extent Tew '640 did not teach optical sensors, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	87	". . . one or more optical sensors, optically coupled to said fiber collimator output ports."

1857. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add one or more sensors

optically coupled to fiber collimator ports to Tew '640 (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Tew '640 (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1858. A POSITA also would have combined other prior art references with Tew '640, incorporating these limitations into Tew '640. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference.

1859. A POSITA would have been motivated to combine Tew '640 (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks and/or Smith to include these limitations for at least the following reasons. A POSITA would have recognized based on the problems to be solved and the teachings of the prior art that each output port carries a single spectral channel and that sensors were often coupled to output ports. For example, Smith describes "an optical monitoring system [that] is incorporated by fusing two monitoring fibers 210, 212 to the output fibers 166, 168 to form Y-couplers 214, 216 coupling about 10% of the optical output power to the monitoring fibers 212, 216." *See* Smith at 13:7-20 (emphasis added); see also id. at 9:7-46, 11:39-46, 14:16-32, Figs. 8, 11-13; *see also* Smith Prov. at 11:2-13, Fig. 4. As another Example, Sparks discloses "measuring the optical signal power comprises at least one of measuring the input optical signal power and measuring the output optical signal power." Sparks at 2:44-47; *see also* Sparks at 2:39-43; Sparks at 2:51-65; Sparks at 2:66-3:2; Sparks at 3:34-36. A POSITA would have been motivated to modify Tew '640 because it was within such person's knowledge to combine or modify the prior art to

include various features omitted from any single prior art reference or combination of references.

(viii) *One-dimensional array of collimator-alignment mirrors*

1860. To the extent Tew ’640 did not teach “a one-dimensional array of collimator-alignment mirrors,” these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
’906 Patent	100-f	“. . . a one-dimensional array of collimator-alignment mirrors . . . .”

1861. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add a one dimensional array of mirrors to Tew ’640 (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Tew ’640 (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1862. A POSITA also would have combined other prior art references with Tew ’640, incorporating these limitations into Tew ’640. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.k, Raj taught these limitations, and I incorporate that analysis by reference.

1863. A POSITA would have been motivated to combine Tew ’640 (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Rose, and/or Raj to include these limitations for at least the following reasons. A POSITA would be motivated to combine or modify the prior art to have a one-dimensional array of input and output ports such that “the ultimate disposition of each channel on each fiber … may be controlled by the MEMS element … to specifically direct or route each input channel to a particular output fiber” with “relatively high precision” and “compact arrangement.” *See, e.g.*, Raj at 4:45-52. A POSITA would have recognized that a one-dimensional array of mirrors positioned as a row or column was a known arrangement commonly used in optical systems. Furthermore, Sparks discloses an array of modules having inputs and outputs. “By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array.” Sparks at 4:33-35; *see also* Rose at FIG. 12B (showing mirrors 220, 1122 in a one dimensional array).

b) Obviousness Based on Smith

1864. In my opinion, a POSITA would find the Asserted Claims would have been obvious in view of Smith and the following, alone or in combination:

- The knowledge of a POSITA;
- Tew ’640;
- Solgaard;
- Lalonde;
- Sparks
- Rose;
- Bouevitch;

- Tew ’520;
- Tew ’070;
- Carr;
- Raj;
- Kramer; and
- Yuan.

I analyzed the scope and content of Smith above in Section IX.1.b, and I incorporate that analysis by reference. Below, I have selected certain example limitations from the Asserted Claims and explained why it would have been obvious to combine Smith (alone or in combination with the common knowledge of a POSITA and/or other prior art) to include these limitations. However, to the extent any limitations are absent from Smith that are not specifically addressed below, such limitations would have been within the common knowledge of a POSITA, and a POSITA would have been motivated to combine Smith (alone or in combination with the common knowledge of a POSITA and/or other prior art) with the other prior art references discussed throughout this report to include those limitations.

(i) *Maintaining a predetermined coupling*

1865. To the extent Smith did not teach maintaining a predetermined coupling, this limitation would have been within the common knowledge of a POSITA and was disclosed in the prior art. This specific limitation is found in the following claims:

Patent	**Claim(s)**	**Limitations**
’906 Patent	69	“. . . thereby maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports.”
’906 Patent	89-e	“. . . for maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator

Patent	Claim(s)	Limitations
		output ports."
'906 Patent	116	". . . thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports."
'906 Patent	134	". . . to maintain a predetermining coupling of each spectral channel directed into one of said output ports."

1866. As an initial matter, this limitation was within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add "maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports" to Smith (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Smith (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1867. A POSITA also would have combined other prior art references with Smith, incorporating these limitations into Smith. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.f, Bouevitch taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.i, Tew '070 taught these limitations, and I incorporate that analysis by reference. As another example, as

discussed above in Section IX.1.j, Carr taught these limitations, and I incorporate that analysis by reference.

1868. A POSITA would have been motivated to combine Smith (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Rose, Lalonde, Bouevitch, Tew ’070, and/or Carr to include these limitations for at least the following reasons. Maintaining power levels of the spectral channels coupled into the output ports at a predetermined value was well-known in the prior art. For example, Smith discloses that “all wavelength channels on [the] output fiber[s] should have the same intensity so that optical receivers and other components located downstream will detect wavelength channels of equal intensity.” Smith at 9:59-63. It would have been obvious for someone skilled in the art to maintain power levels of the spectral channels at a predetermined value in a cross-connect or ROADM because of many well-known benefits conferred. As Smith explains, such power equalization at a predetermined value is desired in order to, for example, satisfy the dynamic range restrictions of downstream receivers and to satisfy the amplifier input limits of downstream receivers. Smith at 10:47-55. The prior art recognized that, although one could use “optical amplifiers” to “amplify optical signals and compensate loss,” “the entire WDM signal and their gain spectrum is typically not flat[,]” which would motivate a person of ordinary skill in the art to combine or modify the prior art to “maintain the power levels of different signals”, including to maintain them such that they are “the same or at least in predetermined ratios.” *See, e.g.*, Smith at 6:18–23. The prior art also recognized the importance of dynamically controlling power levels and implementing feedback control to, for example, “maintain a significant degree of uniformity of power levels across the WDM spectrum,” and to account for “internal variations of optical characteristics and misalignments” and “mechanical stress,” (*see, e.g.*, *id.* at

6:24–50; *see also, e.g.*, Rose at 11:37–41). The prior art also recognized that power levels could be adjusted by, for example, (1) the number of mirrors used, (2) the angle of the mirrors, and (3) the location of the mirrors (Tew '070, ¶ 37; *see also, e.g.*, Smith at 6:55–57, 7:32–44, 7:49–52; Carr at 11:11–12:50), and a POSITA would have been motivated to combine or modify the prior art to use any or all of these techniques. As another example, Bouevitch discloses a modifying means that can control the angle of a reflected beam. "Each sub-beam of the spatially dispersed beam of light is selectively reflected back to the spherical reflector 910 at a predetermined angle, generally along a different optical path from which it came. Variable attenuation is provided by the modifying means 950." Bouevitch at 12:55-60. Bouevitch also discloses a pivotable MEMS array. "Moreover, it is also within the scope of the instant invention for the MEMs array to flip in either a horizontal or vertical direction, relative to the dispersion plane. Furthermore, any combination of the above embodiments and/or components are possible." Bouevitch at 15:30-34; *see also* Bouevitch at 14:5-65.

(ii) *A beam focuser having first and second focal points*

1869. To the extent Smith did not teach a beam focuser having first and second focal points, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	81	". . . wherein said beam-focuser comprises a focusing lens having first and second focal points."
'906 Patent	82	". . . wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens."
'906 Patent	123	". . . wherein said beam-focuser comprises a focusing lens having first and second focal points, and wherein said wavelength-separator and said channel micromirrors are

Patent	**Claim(s)**	**Limitations**
		placed respectively at said first and second focal points."

1870. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add "wherein said beam-focuser comprises a focusing lens having first and second focal points, and wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points" to Smith (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Smith (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1871. A POSITA also would have combined other prior art references with Smith, incorporating these limitations into Smith. For example, as discussed above in Section IX.1.a, Tew '640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference.

1872. A POSITA would have been motivated to combine Smith (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew '640 and/or Rose to include these limitations for at least the following reasons. As explained above, a beam focuser was a well-known optical component utilized in the fiber optics industry for fiber communications that focuses or converges the optical signal or light beam. Where an input optical signal is collimated, the focuser will typically reverse the collimation of the optical signal and reduces that beam to a focal point. A POSITA would have been motivated to modify

Smith because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references. Furthermore, Tew '640 discloses light striking an optic to focus a beam onto multiple focal points. *See* Tew '640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10; *see* Tew '640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11. Rose also discloses a focusing optic focusing light onto multiple focal points. *See* Rose at 18:42-49; *see also* Rose at FIG. 33. Further, Tew '640 and Rose disclose the light being reflected onto micromirrors and reflectors, and a POSITA could and would have known to place micromirrors and reflectors at the focal points.

(iii) *Quarter-wave plate*

1873. To the extent Smith did not teach a quarter-wave plate, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	85	". . . a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors."
'906 Patent	125	". . . a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors."

1874. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add "a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors" to Smith (alone or in combination with other prior art) to arrive at the claimed invention. A

POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Smith (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1875. A POSITA also would have combined other prior art references with Smith, incorporating these limitations into Smith. For example, as discussed above in Section IX.1.c, Solgaard taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.f, Bouevitch taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference.

1876. A POSITA would have been motivated to combine Smith (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Solgaard, Bouevitch, and/or Rose to include these limitations for at least the following reasons. The prior art also recognized that it was "well understood by those in the art" that "wave plates" (such as quarter- or half-wave plates) could be inserted, for example, "so as to substantially eliminate polarization dependence within the switch." *See, e.g.*, Smith at 5:39–42; *see also, e.g.*, Solgaard at 8:18–20; Bouevitch at 5:49–60, 7:23–44; Rose at 19:56-59. A POSITA would have been motivated to modify Smith to include wave plates, such as quarter- or half-wave plates to, for example, substantially eliminate polarization dependence or sensitivity. As another example, Bouevitch discloses a quarter wave plate interposed between a birefringent element and a reflector on a MEMs array. "A beam of light having a predetermined polarization state launched from port 102 a is dispersed into sub-beams and is passed through a birefringent element 156 and quarter waveplate 157. The birefringent element 156 is arranged not to affect the polarization of the sub-beam of light. After passing through the quarter waveplate 157, the beam

of light becomes circularly polarized and is incident on a predetermined reflector of the MEMS array 155. The reflector reflects the sub-beam of light incident thereon back to the quarter waveplate." Bouevitch at 7:23-35; *see also* Bouevitch at FIG. 5 (element 157).

c) Obviousness Based on Solgaard

1877. In my opinion, a POSITA would find the Asserted Claims would have been obvious in view of Solgaard and the following, alone or in combination:

- The knowledge of a POSITA;
- Tew '640;
- Smith;
- Lalonde;
- Sparks
- Rose;
- Bouevitch;
- Tew '520;
- Tew '070;
- Carr;
- Raj;
- Kramer; and
- Yuan.

I analyzed the scope and content of Solgaard above in Section IX.1.c, and I incorporate that analysis by reference. Below, I have selected certain example limitations from the Asserted Claims and explained why it would have been obvious to combine Solgaard (alone or in combination with the common knowledge of a POSITA and/or other prior art) to include these

limitations. However, to the extent any limitations are absent from Solgaard that are not specifically addressed below, such limitations would have been within the common knowledge of a POSITA, and a POSITA would have been motivated to combine Solgaard (alone or in combination with the common knowledge of a POSITA and/or other prior art) with the other prior art references discussed throughout this report to include those limitations.

(i) *Servo-control assembly*

1878. To the extent Solgaard did not teach "a servo-control assembly" and "wherein said servo-control assembly maintains said power levels at predetermined values," these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'905 Patent	25	". . . a servo-control assembly . . . ."
'905 Patent	26	". . . wherein said servo-control assembly maintains said power levels at predetermined values."
'906 Patent	69	". . . a servo-control assembly . . . ."
'906 Patent	70, 90, 117	". . . said servo-control assembly . . . ."
'906 Patent	71, 91	". . . wherein said servo-control assembly maintains said power levels at a predetermined value."
'906 Patent	89-e	". . . a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for maintaining a predetermined coupling of each reflected spectral channel into one of said fiber collimator output ports."
'906 Patent	116	". . . a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports."

Patent	Claim(s)	Limitations
’906 Patent	134	“. . . to maintain a predetermining coupling of each spectral channel directed into one of said output ports.”
’906 Patent	135	“. . . the step of maintaining power levels of said spectral channels directed into said output ports at a predetermining value.”

1879. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add “a servo-control assembly” and “wherein said servo-control assembly maintains said power levels at predetermined values” to Solgaard (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Solgaard (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1880. A POSITA also would have combined other prior art references with Solgaard, incorporating these limitations into Solgaard. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.a, Tew ’640 taught the “a servo-control assembly” limitation, and I incorporate that analysis by reference.

1881. A POSITA would have been motivated to combine Solgaard (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Rose, Smith, and/or Tew ’640 to include these limitations for at least the following reasons. A

POSITA would have been motivated to add a servo-control assembly to Solgaard to use feedback power measurements to control the beam-deflecting elements. It is well-recognized in the prior art to provide optical feedback control of micromirrors and other beam-deflecting elements in an optical switching device such as a ROADM or optical cross-connect. Combining such references would have been nothing more than using known techniques of spectral monitoring, feedback, and control processing in optical interconnects to provide a servo-control assembly to similar optical interconnects in the same ways and for the same purposes. Even the Asserted Patents recognize that a POSITA would have known "how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application." '905 Patent at 12:33-36. The prior art also recognized the importance of using a servo control system to achieve a predetermined output power by controlling the misalignment, or efficiency, of the optical beam path. *See* Sparks at 3:22-27; *see also* Sparks at Abstract; *see also* Sparks at 2:20-25; *see also* Sparks at 3:3-9; *see also* Sparks at 3:14-21; *see also* Sparks at 3:37-43; *see also* Sparks at 4:38-40 ("a closed-loop servo control system is employed. The control system is normally used to provide high optical coupling efficiency"). Furthermore, the components used for performing the functions of spectral monitoring and feedback servo-control of the mirrors are the same or analogous to the components used for channel switching functions. It would have been obvious for a POSITA to try to use these common components for both the functions of optical channel switching and for power control in a feedback loop, as there would have been a reasonable expectation of success and a common sense advantage in reducing cost and size of the system by reducing the number of components needed to perform both functions.

(ii) *Fiber collimator add and drop ports*

1882. To the extent Solgaard did not teach fiber collimator add and drop ports, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'905 Patent	32	". . . wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels."

1883. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add "wherein said fiber collimator one or more other ports comprise a fiber collimator add port and a fiber collimator drop port for respectively adding second and dropping first spectral channels" to Solgaard (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Solgaard (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1884. A POSITA also would have combined other prior art references with Solgaard, incorporating these limitations into Solgaard. For example, as discussed above in Section IX.1.a, Tew '640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate

that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.h, Tew ’520 taught these limitations, and I incorporate that analysis by reference.

1885. A POSITA would have been motivated to combine Solgaard (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew ’640, Sparks, Rose, Smith, Lalonde, and/or Tew ’520 to include these limitations for at least the following reasons. It would have been obvious to a POSITA to have combined prior art elements according to known methods and/or common sense to yield predictable results with a reasonable expectation of success. For example, the prior art also recognized that holding an optical fiber in a ferrule with a collimator lens, such as a self-focusing gradient index (GRIN) lens (what the Asserted Patents arguably identify as at least one example of “a fiber collimator” *see, e.g.*, ’905 Patent at 9:34–38) “simplifies handling of the optical fibers.” *See, e.g.*, Tew ’520 at 5:45–50. The prior art similarly recognized that “[c]ollimated light is desired due to the typically small mirror tilt angle provided by common micromirror devices.” *See, e.g.*, *id.* at 5:49–51. It would have been obvious to have utilized any of the OXC prior-art references that support add and/or drop ports in any of the OADM or other optical switching prior-art references to achieve an OADM that controls a set of mirrors to add an input light beam from an add port and to direct one or more optical channels to a drop port. Combining such references with Solgaard would have involved nothing more than using known techniques of fiber optic coupling and mirror control in optical switching devices.

(iii) *Pivoting about two axes and continuously controllable*

1886. To the extent Solgaard did not teach “said channel micromirrors being pivotal about two axes and being . . . continuously controllable . . . to control the power of said received

spectral channels coupled into said fiber collimator output ports," these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	68-d	". . . said channel micromirrors being pivotal about two axes and being . . . continuously controllable . . . to control the power of said received spectral channels coupled into said fiber collimator output ports."
'906 Patent	115-e	". . . said channel micromirrors being pivotal about two axes and being . . . continuously controllable . . . to control the power of said received spectral channels coupled into said output ports . . . ."
'906 Patent	133-d	". . . continuously controlling said beam-deflecting elements in two dimensions . . . to control the power of the spectral channels coupled into said selected output ports"

1887. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add "said channel micromirrors being pivotal about two axes and being . . . continuously controllable . . . to control the power of said received spectral channels coupled into said fiber collimator output ports" to Solgaard (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Solgaard (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1888. A POSITA also would have combined other prior art references with Solgaard, incorporating these limitations into Solgaard. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another

example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.f, Bouevitch taught these limitations, and I incorporate that analysis by reference.

1889. A POSITA would have been motivated to combine Solgaard (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Smith, Lalonde, and/or Bouevitch to include these limitations for at least the following reasons. The prior art recognized that it was "desirable to integrate" into optical networks systems that utilized arrays of mirrors that were tiltable about two axes, at least so as to dynamically control power levels. *See, e.g.*, Smith at 6:51–61 (describing U.S. Patent No. 6,263,123 to Bishop et al.). Lalonde also describes `3-D MEMS` devices have emerged as the photonic switch technology of choice for large fabric switches. 3-D MEMS is a term used by the Applicant for a mirror mounted on a frame that can be rotated along two axes, giving it four degrees of freedom. The 3-D MEMS devices are arranged preferably in a matrix, which comprises besides the mirrors a control system for positioning the mirrors independently." *See* Lalonde at 2:30-37 (emphasis added); *see also id.* at 3:16-18, 4:61-64, 5:34-57, 6:9-35, 6:54-66, 7:13-42, 7:65-8:14, 8:46-60, Figs. 3A-4B. A POSITA would have not only been motivated to combine or modify the prior art so as to dynamically control power levels and implement feedback control but would have been specifically been motivated to combine or modify the prior art to incorporate arrays of mirrors tiltable about two axes to do so. Sparks also discloses light that can be reflected off a movable mirror which precisely directs the beam in two axes. Sparks at 4:15-23; *see also* Sparks at FIG. 1. Bouevitch also discloses a pivotable MEMS array. "Moreover, it is

also within the scope of the instant invention for the MEMs array to flip in either a horizontal or vertical direction, relative to the dispersion plane. Furthermore, any combination of the above embodiments and/or components are possible." Bouevitch at 15:30-34; *see also* Bouevitch at 14:5-65. Bouevitch also discusses the goal of controlling the MEMS mirror is to effect the add/drop process, which includes reflecting the spectral channels to selected add/drop ports. Bouevitch at 14:66-14:18. Bouevitch also discusses mirrors can be continuously pivotable. Bouevitch at 7:35-37; *see also* Bouevitch at 12:59-60. A POSITA would have been motivated to modify Solgaard because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references.

(iv) *Focal Points*

1890. To the extent Solgaard did not teach "wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens," these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	82	". . . wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens."
'906 Patent	123	". . . wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points."

1891. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add "wherein said

wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens" to Solgaard (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Solgaard (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1892. A POSITA also would have combined other prior art references with Solgaard, incorporating these limitations into Solgaard. For example, as discussed above in Section IX.1.a, Tew '640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference.

1893. A POSITA would have been motivated to combine Solgaard (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew '640, and/or Rose, to include these limitations for at least the following reasons. A POSITA would have recognized based on the problems to be solved and the teachings of the prior art that a wavelength separator and micromirrors would have been placed at respective focal points in the system. A POSITA would have been motivated to modify Solgaard because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references.

(v) *Optical sensors*

1894. To the extent Solgaard did not teach "wherein each fiber collimator output port carries a single one of said spectral channels" and "one or more optical sensors, optically coupled to said fiber collimator output ports," these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
’906 Patent	86	“. . . wherein each fiber collimator output port carries a single one of said spectral channels.”
’906 Patent	87	“. . . one or more optical sensors, optically coupled to said fiber collimator output ports.”

1895. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add “wherein each fiber collimator output port carries a single one of said spectral channels” and “one or more optical sensors, optically coupled to said fiber collimator output ports” to Solgaard (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Solgaard (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1896. A POSITA also would have combined other prior art references with Solgaard, incorporating these limitations into Solgaard. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught the “wherein each fiber collimator output port carries a single one of said spectral channels” limitation, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.a, Tew ’640 taught the “wherein each fiber collimator output port carries a single one of said spectral channels” limitation, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught the “wherein

each fiber collimator output port carries a single one of said spectral channels" limitation, and I incorporate that analysis by reference.

1897. A POSITA would have been motivated to combine Solgaard (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Smith, Lalonde, Tew '640, and/or Rose, to include these limitations for at least the following reasons. A POSITA would have recognized based on the problems to be solved and the teachings of the prior art that each output port carries a single spectral channel and that sensors were often coupled to output ports. For example, Smith describes "an optical monitoring system [that] is incorporated by fusing two monitoring fibers 210, 212 to the output fibers 166, 168 to form Y-couplers 214, 216 coupling about 10% of the optical output power to the monitoring fibers 212, 216." *See* Smith at 13:7-20 (emphasis added); see also id. at 9:7-46, 11:39-46, 14:16-32, Figs. 8, 11-13; *see also* Smith Prov. at 11:2-13, Fig. 4. As another Example, Sparks discloses "measuring the optical signal power comprises at least one of measuring the input optical signal power and measuring the output optical signal power." Sparks at 2:44-47; *see also* Sparks at 2:39-43; Sparks at 2:51-65; Sparks at 2:66-3:2; Sparks at 3:34-36. A POSITA would have been motivated to modify Solgaard because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references.

(vi) *One-dimensional array of collimator-alignment mirrors*

1898. To the extent Solgaard did not teach "a one-dimensional array of collimator-alignment mirrors," this limitation would have been within the common knowledge of a POSITA and were disclosed in the prior art. This specific limitation is found in the following claims:

Patent	Claim(s)	Limitations
’906 Patent	100-f	“. . . a one-dimensional array of collimator-alignment mirrors . . . .”

1899. As an initial matter, this limitation was within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add “a one-dimensional array of collimator-alignment mirrors” to Solgaard (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Solgaard (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1900. A POSITA also would have combined other prior art references with Solgaard, incorporating these limitations into Solgaard. For example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.k, Raj taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference.

1901. A POSITA would have been motivated to combine Solgaard (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Smith, Lalonde, Raj, Sparks, and/or Rose to include these limitations for at least the following reasons. A POSITA would be motivated to combine or modify the prior art to have a one-dimensional array of input and output ports such that “the ultimate disposition of each channel on each fiber

… may be controlled by the MEMS element … to specifically direct or route each input channel to a particular output fiber" with "relatively high precision" and "compact arrangement." *See, e.g.*, Raj at 4:45-52. A POSITA would have recognized that a one-dimensional array of mirrors positioned as a row or column was a known arrangement commonly used in optical systems. Furthermore, Sparks discloses an array of modules having inputs and outputs. "By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array." Sparks at 4:33-35; *see also* Rose at FIG. 12B (showing mirrors 220, 1122 in a one dimensional array).

(vii) *Pass-through port*

1902. To the extent Solgaard did not teach a pass-through port, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	115-b	". . . a pass-through port and one or more drop ports . . . ."
'906 Patent	115-e	". . . whereby said fiber collimator pass-through port receives a subset of said spectral channels."
'906 Patent	131	". . . wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports."

1903. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add "a pass-through port and one or more drop ports" and "whereby said fiber collimator pass-through port receives a subset of said spectral channels" and "wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports" to Solgaard (alone or in

combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Solgaard (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1904. A POSITA also would have combined other prior art references with Solgaard, incorporating these limitations into Solgaard. For example, as discussed above in Section IX.1.a, Tew '640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.f, Bouevitch taught these limitations, and I incorporate that analysis by reference.

1905. A POSITA would have been motivated to combine Solgaard (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew '640 Smith, and/or Bouevitch to include these limitations for at least the following reasons. A POSITA would have recognized that pass-through ports and drop ports were commonly known components. For example, Tew '640 discloses a pass-through port that can be used to re-transmit a signal: "[w]hen the switch is in a first position, the signal on the first input 110 is passed through to the first output 112 and retransmitted." Tew '640 at 4:30-42; *see also* Provisional Application No. 60/236,532 at 8:12-19; Tew '640 at FIG. 1; Provisional Application No. 60/236,532 at FIG. 1. As such, the pass-through port can essentially serve as an auxiliary input port. A POSITA would have been motivated to modify Solgaard because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references. Bouevitch discloses a passthrough port receiving and propagating light. Referring to FIG. 11, reflector 51 is orientated

such that the sub-beam of light corresponding to λ1 incident thereon, is reflected back along the same optical path to the lens 90, passes through port 85 again, and propagates to port 2 of circulator 80a where it is circulated to port 3. Reflector 52, however, is orientated such that the sub-beam of light corresponding to λ2 is reflected back along a different optical path. Accordingly, the dropped signal corresponding to wavelength λ2 is returned to the lens 90, passes through port 87, propagates to port 2 of the second circulator 80b, and is circulated to port 3." Bouevitch at 14:55-65; *see also* Bouevitch at 6:20-25 (that the modifying means of the ROADM allows a light beam to pass through unchanged).

d) Obviousness Based on Lalonde

1906. In my opinion, a POSITA would find the Asserted Claims would have been obvious in view of Lalonde and the following, alone or in combination:

- The knowledge of a POSITA;
- Tew '640;
- Smith;
- Solgaard;
- Sparks
- Rose;
- Bouevitch;
- Tew '520;
- Tew '070;
- Carr;
- Raj;
- Kramer; and

- Yuan.

I analyzed the scope and content of Lalonde above in Section IX.d, and I incorporate that analysis by reference. Below, I have selected certain example limitations from the Asserted Claims and explained why it would have been obvious to combine Lalonde (alone or in combination with the common knowledge of a POSITA and/or other prior art) to include these limitations. However, to the extent any limitations are absent from Lalonde that are not specifically addressed below, such limitations would have been within the common knowledge of a POSITA, and a POSITA would have been motivated to combine Lalonde (alone or in combination with the common knowledge of a POSITA and/or other prior art) with the other prior art references discussed throughout this report to include those limitations.

(i) *Servo-control assembly*

1907. To the extent Lalonde did not teach "a servo-control assembly" and "wherein said servo-control assembly maintains said power levels at predetermined values," these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'905 Patent	25	". . . a servo-control assembly . . . ."
'905 Patent	26	". . . wherein said servo-control assembly maintains said power levels at predetermined values."
'906 Patent	69	". . . a servo-control assembly . . . ."
'906 Patent	70, 90, 117	". . . said servo-control assembly . . . ."
'906 Patent	71, 91	". . . wherein said servo-control assembly maintains said power levels at a predetermined value."
'906 Patent	89-e	". . . a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports, for maintaining a predetermined coupling of each

Patent	Claim(s)	Limitations
		reflected spectral channel into one of said fiber collimator output ports.”
’906 Patent	116	“. . . a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports.”
’906 Patent	134	“. . . to maintain a predetermining coupling of each spectral channel directed into one of said output ports.”
’906 Patent	135	“. . . the step of maintaining power levels of said spectral channels directed into said output ports at a predetermining value.”

1908. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add “a servo-control assembly” and “wherein said servo-control assembly maintains said power levels at predetermined values” to Lalonde (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Lalonde (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1909. A POSITA also would have combined other prior art references with Lalonde, incorporating these limitations into Lalonde. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as

discussed above in Section IX.1.a, Tew ’640 taught the “a servo-control assembly” limitation, and I incorporate that analysis by reference.

1910. A POSITA would have been motivated to combine Lalonde (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Rose, Smith, and/or Tew ’640 to include these limitations for at least the following reasons. A POSITA would have been motivated to add a servo-control assembly to Lalonde to use feedback power measurements to control the beam-deflecting elements. It is well-recognized in the prior art to provide optical feedback control of micromirrors and other beam-deflecting elements in an optical switching device such as a ROADM or optical cross-connect. Combining such references would have been nothing more than using known techniques of spectral monitoring, feedback, and control processing in optical interconnects to provide a servo-control assembly to similar optical interconnects in the same ways and for the same purposes. Even the Asserted Patents recognize that a POSITA would have known “how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application.” ‘905 Patent at 12:33-36. The prior art also recognized the importance of using a servo control system to achieve a predetermined output power by controlling the misalignment, or efficiency, of the optical beam path. *See* Sparks at 3:22-27; *see also* Sparks at Abstract; *see also* Sparks at 2:20-25; *see also* Sparks at 3:3-9; *see also* Sparks at 3:14-21; *see also* Sparks at 3:37-43; *see also* Sparks at 4:38-40 (“a closed-loop servo control system is employed. The control system is normally used to provide high optical coupling efficiency”). Furthermore, the components used for performing the functions of spectral monitoring and feedback servo-control of the mirrors are the same or analogous to the components used for channel switching functions. It would

have been obvious for a POSITA to try to use these common components for both the functions of optical channel switching and for power control in a feedback loop, as there would have been a reasonable expectation of success and a common sense advantage in reducing cost and size of the system by reducing the number of components needed to perform both functions.

(ii) *Silicon micromachined mirror*

1911. To the extent Lalonde did not teach "a silicon micromachined mirror," this limitation would have been within the common knowledge of a POSITA and were disclosed in the prior art. This specific limitation is found in the following claims:

Patent	Claim(s)	Limitations
'906 Patent	79	". . . a silicon micromachined mirror."
'906 Patent	96	". . . a silicon micromachined mirror."
'906 Patent	122	". . . a silicon micromachined mirror."
'906 Patent	129	". . . a silicon micromachined mirror."

1912. As an initial matter, this limitation was within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add "a silicon micromachined mirror" to Lalonde (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Lalonde (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1913. A POSITA also would have combined other prior art references with Lalonde, incorporating these limitations into Lalonde. For example, as discussed above in Section IX.1.a, Tew '640 taught these limitations, and I incorporate that analysis by reference. As another

example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.c, Solgaard taught these limitations, and I incorporate that analysis by reference.

1914. A POSITA would have been motivated to combine Lalonde (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew '640, Smith, and/or Solgaard, to include these limitations for at least the following reasons. A POSITA would have been motivated to modify Lalonde because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references. In addition, it was common knowledge in the prior art to use silicon for micromirrors and a POSITA would have been motivated to use such a material. Solheim Tr. at 42:21-43:3 ("Q And then, back in 2000, what material would MEMS mirrors typically be manufactured from? MR. BECKER: Object. Form. THE WITNESS: Typically they would be manufactured from -- from silicon, and would use some sort of metal coating to create the traces and may use either polished silicon or metal as the mirror -- mirrored surface."). Tew '640 also discloses silicon micromirrors. Tew '640 also discloses "[t]he micromirror 300 is fabricated on a semiconductor, typically silicon, substrate 304." Tew '640 at 5:19-32; *see also* Provisional Application No. 60/236,532 at 10:3-11. Rose discloses the switches and the reflectors can be as a MEMS device having micromachined deformable mirrors. "An embodiment of a reflective switch 1516 that may be used in the embodiment of OADM of in FIGS. 15 and 16 is illustrated in FIGS. 17 A and 17B. The switch 1516 may be a MEMs device having a reflecting surface 1518 that can be moved between at least two positions. The switch may be, for example, a linear MMDM (micromachined deformable mirror) supplied by Flexible Optics BV, Netherlands." Rose at 14:55-61. A

POSITA would understand the reflectors could be silicon MEMS micromachined mirrors since these types of devices were known in the art and commercially available.

(iii) *A beam focuser having first and second focal points*

1915. To the extent Lalonde did not teach a beam focuser having first and second focal points, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
’906 Patent	81	“. . . wherein said beam-focuser comprises a focusing lens having first and second focal points.”
’906 Patent	82	“. . . wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points of said focusing lens.”
’906 Patent	123	“. . . wherein said beam-focuser comprises a focusing lens having first and second focal points, and wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points.”

1916. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add “wherein said beam-focuser comprises a focusing lens having first and second focal points, and wherein said wavelength-separator and said channel micromirrors are placed respectively at said first and second focal points” to Lalonde (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Lalonde (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1917. A POSITA also would have combined other prior art references with Lalonde, incorporating these limitations into Lalonde. For example, as discussed above in Section IX.1.a, Tew ’640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.c, Solgaard taught the “wherein said beam-focuser comprises a focusing lens having first and second focal points” limitation, and I incorporate that analysis by reference.

1918. A POSITA would have been motivated to combine Lalonde (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew ’640, Rose, and/or Solgaard to include these limitations for at least the following reasons. As explained above, a beam focuser was a well-known optical component utilized in the fiber optics industry for fiber communications that focuses or converges the optical signal or light beam. Where an input optical signal is collimated, the focuser will typically reverse the collimation of the optical signal and reduces that beam to a focal point. A POSITA would have been motivated to modify Lalonde because it was within such person’s knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references.

(iv) *Quarter-wave plate*

1919. To the extent Lalonde did not teach a quarter-wave plate, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
’906 Patent	85	“. . . a quarter-wave plate optically interposed between said wavelength-separator and said channel

Patent	**Claim(s)**	**Limitations**
		micromirrors.”
’906 Patent	125	“. . . a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors.”

1920. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add “a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors” to Lalonde (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Lalonde (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1921. A POSITA also would have combined other prior art references with Lalonde, incorporating these limitations into Lalonde. For example, as discussed above in Section IX.1.c, Solgaard taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.f, Bouevitch taught these limitations, and I incorporate that analysis by reference.

1922. A POSITA would have been motivated to combine Lalonde (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Solgaard and/or Bouevitch to include these limitations for at least the following reasons. The prior art also recognized that it was “well understood by those in the art” that “wave plates” (such as quarter- or half-wave plates) could be inserted, for example, “so as to substantially eliminate polarization dependence within the switch.” *See, e.g.*, Smith at 5:39–42; *see also, e.g.*, Solgaard at 8:18–20; Bouevitch at 5:49–60, 7:23–44; Rose at 19:56-59. A POSITA would have been

motivated to modify Lalonde to include wave plates, such as quarter- or half-wave plates to, for example, substantially eliminate polarization dependence or sensitivity. As another example, Bouevitch discloses a quarter wave plate interposed between a birefringent element and a reflector on a MEMs array. "A beam of light having a predetermined polarization state launched from port 102 a is dispersed into sub-beams and is passed through a birefringent element 156 and quarter waveplate 157. The birefringent element 156 is arranged not to affect the polarization of the sub-beam of light. After passing through the quarter waveplate 157, the beam of light becomes circularly polarized and is incident on a predetermined reflector of the MEMS array 155. The reflector reflects the sub-beam of light incident thereon back to the quarter waveplate." Bouevitch at 7:23-35; *see also* Bouevitch at FIG. 5 (element 157).

(v) *Optical sensors*

1923. To the extent Lalonde did not teach optical sensors, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	87	". . . one or more optical sensors, optically coupled to said fiber collimator output ports."

1924. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add "one or more optical sensors, optically coupled to said fiber collimator output ports" to Lalonde (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to

Lalonde (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1925. A POSITA also would have combined other prior art references with Lalonde, incorporating these limitations into Lalonde. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference.

1926. A POSITA would have been motivated to combine Lalonde (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks and/or Smith, to include these limitations for at least the following reasons. A POSITA would have recognized based on the problems to be solved and the teachings of the prior art that each output port carries a single spectral channel and that sensors were often coupled to output ports. For example, Smith describes "an optical monitoring system [that] is incorporated by fusing two monitoring fibers 210, 212 to the output fibers 166, 168 to form Y-couplers 214, 216 coupling about 10% of the optical output power to the monitoring fibers 212, 216." *See* Smith at 13:7-20 (emphasis added); see also id. at 9:7-46, 11:39-46, 14:16-32, Figs. 8, 11-13; *see also* Smith Prov. at 11:2-13, Fig. 4. As another Example, Sparks discloses "measuring the optical signal power comprises at least one of measuring the input optical signal power and measuring the output optical signal power." Sparks at 2:44-47; *see also* Sparks at 2:39-43; Sparks at 2:51-65; Sparks at 2:66-3:2; Sparks at 3:34-36. A POSITA would have been motivated to modify Lalonde because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references.

(vi) *Pass-through port*

1927. To the extent Lalonde did not teach a pass-through port, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
’906 Patent	115-b	“. . . a pass-through port and one or more drop ports . . . .”
’906 Patent	115-e	“. . . whereby said fiber collimator pass-through port receives a subset of said spectral channels.”
’906 Patent	131	“. . . wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports.”

1928. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add “a pass-through port” and “whereby said fiber collimator pass-through port receives a subset of said spectral channels” and “wherein said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports” to Lalonde (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Lalonde (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1929. A POSITA also would have combined other prior art references with Lalonde, incorporating these limitations into Lalonde. For example, as discussed above in Section IX.1.a, Tew ’640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate

that analysis by reference. As another example, as discussed above in Section IX.1.f, Bouevitch taught these limitations, and I incorporate that analysis by reference.

1930. A POSITA would have been motivated to combine Lalonde (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew '640, Smith, and/or Bouevitch to include these limitations for at least the following reasons. A POSITA would have recognized that pass-through ports and drop ports were commonly known components. For example, Tew '640 discloses a pass-through port that can be used to re-transmit a signal: "[w]hen the switch is in a first position, the signal on the first input 110 is passed through to the first output 112 and retransmitted." Tew '640 at 4:30-42; *see also* Provisional Application No. 60/236,532 at 8:12-19; Tew '640 at FIG. 1; Provisional Application No. 60/236,532 at FIG. 1. As such, the pass-through port can essentially serve as an auxiliary input port. A POSITA would have been motivated to modify Lalonde because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references. Bouevitch discloses a passthrough port receiving and propagating light. Referring to FIG. 11, reflector 51 is orientated such that the sub-beam of light corresponding to λ1 incident thereon, is reflected back along the same optical path to the lens 90, passes through port 85 again, and propagates to port 2 of circulator 80a where it is circulated to port 3. Reflector 52, however, is orientated such that the sub-beam of light corresponding to λ2 is reflected back along a different optical path. Accordingly, the dropped signal corresponding to wavelength λ2 is returned to the lens 90, passes through port 87, propagates to port 2 of the second circulator 80b, and is circulated to port 3." Bouevitch at 14:55-65; *see also* Bouevitch at 6:20-25 (that the modifying means of the ROADM allows a light beam to pass through unchanged).

e) Obviousness Based on Sparks

1931. In my opinion, before accounting for secondary considerations, a POSITA would find the Asserted Claims obvious in view of Sparks and the foregoing, alone or in combination:

- The knowledge of a POSITA;
- Tew ’640;
- Smith;
- Solgaard;
- Lalonde
- Rose;
- Bouevitch;
- Tew ’520;
- Tew ’070;
- Carr;
- Raj;
- Kramer; and
- Yuan.

I analyzed the scope and content of Sparks above in Section IX.1.e, and I incorporate that analysis by reference. Below, I have selected certain example limitations from the Asserted Claims and explained why it would have been obvious to combine Sparks (alone or in combination with the common knowledge of a POSITA and/or other prior art) to include these limitations. However, to the extent any limitations are absent from Sparks that are not specifically addressed below, such limitations would have been within the common knowledge of a POSITA, and POSITA would have been motivated to combine Sparks (alone or in

combination with the common knowledge of a POSITA and/or other prior art) with the other prior art references discussed throughout this report to include those limitations.

(i) *Add and drop ports*

1932. To the extent Sparks did not teach add and drop ports, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
’905 Patent	27	“. . . ports to be dropped as second spectral channels . . . .”
’905 Patent	32	“. . . add port and . . . drop port . . . .”
’905 Patent	47-c	“. . . one or more drop ports . . . .”
’905 Patent	47-e	“. . . drop ports”
’905 Patent	49-c	“. . . one or more add ports . . . .”
’905 Patent	49-e	“. . . add ports . . . .”
’905 Patent	51-pre	“A method of performing dynamic add and drop in a WDM optical network . . . .”
’905 Patent	51-e	“. . . spectral channels are dropped . . . .”
’905 Patent	51-f	“. . . drop ports”
’906 Patent	115-f	“. . . one or more drop ports”

1933. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add add and drop ports to Sparks (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their

common knowledge to Sparks (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1934. A POSITA also would have combined other prior art references with Sparks, incorporating these limitations into Sparks. For example, as discussed above in Section IX.1.a, Tew ’640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.c, Solgaard taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.f, Bouevitch taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.h, Tew ’520 taught these limitations, and I incorporate that analysis by reference.

1935. A POSITA would have been motivated to combine Sparks (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew ’640, Rose, Lalonde, Smith, Solgaard, Bouevitch, and/or Tew ’520 to include these limitations for at least the following reasons. A POSITA would have recognized that add ports and drop ports were commonly known components. Tew ’640 discloses add and drop ports. *See* Tew ’640 at Abstract; *see also* Provisional Application No. 60/236,532 at Abstract; Tew ’640 at 8:56-64; Provisional Application No. 60/236,532 at 16:17-22. Rose discloses a device “for adding and dropping channels. The device provides programmability in use as an add/drop multiplexer.” *See* Rose at 1:60-68; *see also* Rose at 18:10-20; Rose at 18:56-19:6; Rose at FIGS. 31-33.

1936. It also would have been obvious to a POSITA to have combined prior art elements according to known methods and/or common sense to yield predictable results with a reasonable expectation of success. For example, the prior art also recognized that holding an optical fiber in a ferrule with a collimator lens, such as a self-focusing gradient index (GRIN) lens (what the Asserted Patents arguably identify as at least one example of "a fiber collimator" *see, e.g.*, '905 Patent at 9:34–38) "simplifies handling of the optical fibers." *See, e.g.*, Tew '520 at 5:45–50. The prior art similarly recognized that "[c]ollimated light is desired due to the typically small mirror tilt angle provided by common micromirror devices." *See, e.g.*, *id.* at 5:49–51. It would have been obvious to have utilized any of the OXC prior-art references that support add and/or drop ports in any of the OADM or other optical switching prior-art references to achieve an OADM that controls a set of mirrors to add an input light beam from an add port and to direct one or more optical channels to a drop port. Combining such references with Solgaard would have involved nothing more than using known techniques of fiber optic coupling and mirror control in optical switching devices. Bouevitch discloses both add ports and drop ports. "[A] signal added at port 1 of the second circulator device propagates to port 3 of the second circulator in the second mode of operation and is not collected in the first mode of operation." Bouevitch at 14:33-34; *see also* Bouevitch at FIG. 11. "An express signal launched into port 1 of the circulator 80a propagates to port 3 of the same circulator 80a in a first mode of operation and a dropped signal launched into port one of the circulator 80a propagates to port 3 of the second circulator 80b in a second mode of operation." Bouevitch at 14:28-32; *see also* Bouevitch at FIG. 11.

(ii) *One-dimensional array of ports*

1937. To the extent Sparks did not teach a one-dimensional array of ports, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
’905 Patent	39	“. . . input port, the one or more other . . . ports, and the output port are arranged in a one dimensional array”

1938. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add a one dimensional array of ports to Sparks (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Sparks (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1939. A POSITA also would have combined other prior art references with Sparks, incorporating these limitations into Sparks. For example, as discussed above in Section IX.1.a, Tew ’640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.c, Solgaard taught these limitations, and I incorporate that analysis by reference.

1940. A POSITA would have been motivated to combine Sparks (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew ’640, Rose, Lalonde, Smith, and/or Solgaard to include these limitations for at least the following reasons. Tew ’640 discloses the input fiber, the output fiber, the add fiber, and the drop fiber being arranged in a one-dimensional array. See Tew ’640 at FIG. 4; see also Provisional Application No. 60/236,532 at FIG. 4; see also Rose at FIGS. 31 and 33. Smith also discloses that “[t]wo fiber waveguides 52, 54 and two output fiber waveguides 56, 58 are ***aligned linearly parallel to each other*** to couple into two free-space input beams 60, 62 and two free-space output beams 64, 66.” *See* Smith at 4:16-24 (emphasis added); *see also id.* at Figs. 5, 6; *see also* Smith Prov. at Figs. 6, 7.

(iii) *Silicon micromirrors*

1941. To the extent Sparks did not teach silicon micromirrors, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
’906 Patent	79	“. . . each channel micromirror is a silicon micromachined mirror”
’906 Patent	96	“. . . each channel micromirror is a silicon micromachined mirror”
’906 Patent	122	“. . . each channel micromirror is a silicon micromachined mirror”
’906 Patent	129	“. . . each auxiliary channel micromirror is a silicon micromachined mirror”
’906 Patent	139	“. . . said beam-deflecting elements comprise an array of silicon micromachined mirrors”

1942. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add silicon micromirrors to Sparks (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Sparks (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1943. A POSITA also would have combined other prior art references with Sparks, incorporating these limitations into Sparks. For example, as discussed above in Section IX.1.a, Tew '640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.c, Solgaard taught these limitations, and I incorporate that analysis by reference.

1944. A POSITA would have been motivated to combine Rose (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew '640, Smith, and/or Solgaard to include these limitations for at least the following reasons. A POSITA would have been motivated to combine Lalonde (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew '640, Smith, and/or Solgaard, to include these limitations for at least the following reasons. A POSITA would have been motivated to modify Lalonde because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of

references. In addition, it was common knowledge in the prior art to use silicon for micromirrors and a POSITA would have been motivated to use such a material. Solheim Tr. at 42:21-43:3 ("Q And then, back in 2000, what material would MEMS mirrors typically be manufactured from? MR. BECKER: Object. Form. THE WITNESS: Typically they would be manufactured from -- from silicon, and would use some sort of metal coating to create the traces and may use either polished silicon or metal as the mirror -- mirrored surface."). Tew '640 also discloses silicon micromirrors. Tew '640 also discloses "[t]he micromirror 300 is fabricated on a semiconductor, typically silicon, substrate 304." Tew '640 at 5:19-32; see also Provisional Application No. 60/236,532 at 10:3-11. 167. Rose discloses the switches and the reflectors can be as a MEMS device having micromachined deformable mirrors. "An embodiment of a reflective switch 1516 that may be used in the embodiment of OADM of in FIGS. 15 and 16 is illustrated in FIGS. 17 A and 17B. The switch 1516 may be a MEMs device having a reflecting surface 1518 that can be moved between at least two positions. The switch may be, for example, a linear MMDM (micromachined deformable mirror) supplied by Flexible Optics BV, Netherlands." Rose at 14:55-61. A POSITA would understand the reflectors could be silicon MEMS micromachined mirrors since these types of devices were known in the art and commercially available.

(iv) *A beam focuser having first and second focal points*

1945. To the extent Sparks did not teach a beam focuser having first and second focal points, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	81	". . . a focusing lens having first and second focal points"

Patent	**Claim(s)**	**Limitations**
'906 Patent	82	". . . first and second focal points of said focusing lens"
'906 Patent	123	". . . a focusing lens having first and second focal points"

1946. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add a beam focuser having first and second focal points to Sparks (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Sparks (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1947. A POSITA also would have combined other prior art references with Sparks, incorporating these limitations into Sparks. For example, as discussed above in Section IX.1.a, Tew '640 these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference.

1948. A POSITA would have been motivated to combine Sparks (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew '640 and/or Rose to include these limitations for at least the following reasons. As explained above, a beam focuser was a well-known optical component utilized in the fiber optics industry for fiber communications that focuses or converges the optical signal or light beam. Where an input optical signal is collimated, the focuser will typically reverse the collimation of the optical signal and reduces that beam to a focal point. A POSITA would have been motivated to modify Sparks because it was within such person's knowledge to combine or modify the prior art to

include various features omitted from any single prior art reference or combination of references. Furthermore, Tew ’640 discloses light striking an optic to focus a beam onto multiple focal points. *See* Tew ’640 at FIG. 10; *see also* Provisional Application No. 60/236,532 at FIG. 10; *see* Tew ’640 at FIG. 11; *see also* Provisional Application No. 60/236,532 at FIG. 11. Rose also discloses a focusing optic focusing light onto multiple focal points. *See* Rose at 18:42-49; *see also* Rose at FIG. 33. Further, Tew ’640 and Rose disclose the light being reflected onto micromirrors and reflectors, and a POSITA could and would have known to place micromirrors and reflectors at the focal points.

(v) *Assembly of lenses*

1949. To the extent Sparks did not teach an assembly of lenses, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
’906 Patent	83	“. . . beam-focuser comprises an assembly of lenses”
’906 Patent	98	“. . . beam-focuser comprises one or more lenses

1950. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add an assembly of lenses to Sparks (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Sparks (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1951. A POSITA also would have combined other prior art references with Sparks, incorporating these limitations into Sparks. For example, as discussed above in Section IX.1.a, Tew '640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.c, Solgaard taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.f, Bouevitch taught these limitations, and I incorporate that analysis by reference.

1952. A POSITA would have been motivated to combine Sparks (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew '640, Rose, Solgaard, and/or Bouevitch to include these limitations for at least the following reasons. As explained above, a beam focuser was a well-known optical component utilized in the fiber optics industry for fiber communications that focuses or converges the optical signal or light beam. An assembly of lenses was commonly used for a beam-focuser. For example, Tew '640 discloses light striking a number of optics to focus a beam onto multiple focal points. See Tew '640 at FIG. 10; see also Provisional Application No. 60/236,532 at FIG. 10; See Tew '640 at FIG. 11; see also Provisional Application No. 60/236,532 at FIG. 11. For example, Rose discloses focusing a beam using an assembly of lenses. See Rose at 18:42-49; see also Rose at FIGS. 31-33. Additionally, Solgaard utilizes a lenslet array and a pair of bulk lenses. See Solgaard at 3:54-4:4, Fig. 1. Bouevitch also discloses multiple optical elements (110a, 110b in FIG. 1 below) that can focus a beam. "The optical design includes a diffraction element 120 disposed between and at a focal plane of identical elements 110a and 110b having optical power, respectively. Two ports 102a and 102b are shown at an input/output end with bi-

directional arrows indicating that light launched into port 102a can be transmitted through the optical device and can be reflected backward to the input port from which it was launched 102a, or alternatively, can be switched to port 102b or vice versa in a controlled manner. The input/output ports 102a and 102b are also disposed about one focal plane away from the element having optical power 110a to which they are optically coupled. Although only two input/output ports are shown to facilitate an understanding of this device, a plurality of such pairs of ports is optionally provided. At the other end of the device, modifying means 150 for modifying at least a portion of the light incident thereon is provided about the focal plane of the element having optical power 110b." Bouevitch at 5:15-38; *see also* FIG. 1. A POSITA would have been motivated to modify Spark because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references.

(vi) *Quarter-wave plates*

1953. To the extent Sparks did not teach quarter-wave plates, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	85	". . . a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors."
'906 Patent	125	". . . a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors."

1954. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of

the Art). Accordingly, a POSITA would not need any motivation to add quarter-wave plates to Sparks (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Sparks (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1955. A POSITA also would have combined other prior art references with Sparks incorporating these limitations into Sparks. For example, as discussed above in Section IX.1.c, Solgaard taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.f, Bouevitch taught these limitations, and I incorporate that analysis by reference.

1956. A POSITA would have been motivated to combine Tew ’640 (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Solgaard, Rose, and/or Bouevitch to include these limitations for at least the following reasons. The prior art also recognized that it was “well understood by those in the art” that “wave plates” (such as quarter- or half-wave plates) could be inserted, for example, “so as to substantially eliminate polarization dependence within the switch.” *See, e.g.*, Smith at 5:39–42; *see also, e.g.*, Solgaard at 8:18–20; Bouevitch at 5:49–60, 7:23–44; Rose at 19:56-59. Bouevitch discloses a quarter wave plate interposed between a birefringent element and a reflector on a MEMs array. “A beam of light having a predetermined polarization state launched from port 102 a is dispersed into sub-beams and is passed through a birefringent element 156 and quarter waveplate 157. The birefringent element 156 is arranged not to affect the polarization of the sub-beam of light. After passing through the quarter waveplate 157, the beam of light becomes circularly polarized

and is incident on a predetermined reflector of the MEMS array 155. The reflector reflects the sub-beam of light incident thereon back to the quarter waveplate." Bouevitch at 7:23-35; *see also* Bouevitch at FIG. 5 (element 157). A POSITA would have been motivated to modify Sparks to include wave plates, such as quarter- or half-wave plates to, for example, substantially eliminate polarization dependence or sensitivity.

(vii) *Pass-through port*

1957. To the extent Sparks did not teach a pass-through port, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	115-b	". . . a pass-through port"
'906 Patent	115-e	". . . pass-through port"
'906 Patent	126-e	". . . pass-through port"
'906 Patent	131	". . . pass-through port constitutes one of said fiber collimator auxiliary input ports"
'906 Patent	133	". . . one or more pass-through spectral channels"

1958. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add a pass-through port to Sparks (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Sparks (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1959. A POSITA also would have combined other prior art references with Sparks, incorporating these limitations into Sparks. For example, as discussed above in Section IX.1.a, Tew ’640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.f, Bouevitch taught these limitations, and I incorporate that analysis by reference.

1960. A POSITA would have been motivated to combine Rose (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew ’640, Smith, and/or Bouevitch to include these limitations for at least the following reasons. A POSITA would have recognized that pass-through ports and drop ports were commonly known components. For example, Tew ’640 discloses a pass-through port that can be used to re-transmit a signal: “[w]hen the switch is in a first position, the signal on the first input 110 is passed through to the first output 112 and retransmitted.” Tew ’640 at 4:30-42; *see also* Provisional Application No. 60/236,532 at 8:12-19; Tew ’640 at FIG. 1; Provisional Application No. 60/236,532 at FIG. 1. As such, the pass-through port can essentially serve as an auxiliary input port. A POSITA would have been motivated to modify Rose because it was within such person’s knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references. Bouevitch discloses a passthrough port receiving and propagating light. Referring to FIG. 11, reflector 51 is orientated such that the sub-beam of light corresponding to λ1 incident thereon, is reflected back along the same optical path to the lens 90, passes through port 85 again, and propagates to port 2 of circulator 80a where it is circulated to port 3. Reflector 52, however, is orientated such that the sub-beam of light corresponding to λ2 is reflected back along a different optical path. Accordingly, the dropped signal

corresponding to wavelength λ2 is returned to the lens 90, passes through port 87, propagates to port 2 of the second circulator 80b, and is circulated to port 3." Bouevitch at 14:55-65; *see also* Bouevitch at 6:20-25 (that the modifying means of the ROADM allows a light beam to pass through unchanged).

f) Obviousness Based on Bouevitch

1961. In my opinion, before accounting for secondary considerations, a POSITA would find the Asserted Claims obvious in view of Bouevitch and the foregoing, alone or in combination:

- The knowledge of a POSITA;
- Tew '640;
- Smith;
- Solgaard;
- Lalonde;
- Sparks;
- Rose;
- Tew '520;
- Tew '070;
- Carr;
- Raj;
- Kramer; and
- Yuan.

I analyzed the scope and content of Bouevitch above in Section IX.1.f, and I incorporate that analysis by reference. Below, I have selected certain example limitations from the Asserted

Claims and explained why it would have been obvious to combine Bouevitch (alone or in combination with the common knowledge of a POSITA and/or other prior art) to include these limitations. However, to the extent any limitations are absent from Bouevitch that are not specifically addressed below, such limitations would have been within the common knowledge of a POSITA, and POSITA would have been motivated to combine Bouevitch (alone or in combination with the common knowledge of a POSITA and/or other prior art) with the other prior art references discussed throughout this report to include those limitations.

(i) *A control unit/servo-control assembly*

1962. To the extent Bouevitch did not teach a control unit/a servo-control assembly in communication with channel micromirrors and fiber collimator ports, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	Claim(s)	Limitations
’905 Patent	24	“. . . a control unit . . . .”
’905 Patent	25	“. . . a servo-control assembly . . . .”
’905 Patent	26	“. . . wherein said servo-control assembly maintains said power levels at predetermined values.”
’906 Patent	69	“. . . a servo-control assembly, in communication with said channel micromirrors and said fiber collimator output ports . . . .”
’906 Patent	70	“. . . wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors.”
’906 Patent	90	“. . . wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports, and a processing unit responsive to said power

Patent	Claim(s)	Limitations
		levels for providing control of said channel micromirrors."
'906 Patent	116	". . . a servo-control assembly, in communication with said channel micromirrors and said output ports, for providing control of said channel micromirrors and thereby maintaining a predetermined coupling of each reflected spectral channel into one of said output ports."
'906 Patent	117	". . . wherein said servo-control assembly comprises a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports, and a processing unit responsive to said power levels for providing control of said channel micromirrors."
'906 Patent	134	". . . the step of providing feedback control of said beam-deflecting elements to maintain a predetermining coupling of each spectral channel directed into one of said output ports."

1963. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add a servo-control assembly in communication with channel micromirrors and fiber collimator ports to Bouevitch (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Bouevitch (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1964. A POSITA also would have combined other prior art references with Bouevitch, incorporating these limitations into Bouevitch. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith

taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference.

1965. A POSITA would have been motivated to combine Solgaard (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Rose, and/or Smith to include these limitations for at least the following reasons. A POSITA would have been motivated to add a servo-control assembly to Solgaard to use feedback power measurements to control the beam-deflecting elements. It is well-recognized in the prior art to provide optical feedback control of micromirrors and other beam-deflecting elements in an optical switching device such as a ROADM or optical cross-connect. Combining such references would have been nothing more than using known techniques of spectral monitoring, feedback, and control processing in optical interconnects to provide a servo-control assembly to similar optical interconnects in the same ways and for the same purposes. Even the Asserted Patents recognize that a POSITA would have known "how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application." '905 Patent at 12:33-36. The prior art also recognized the importance of using a servo control system to achieve a predetermined output power by controlling the misalignment, or efficiency, of the optical beam path. *See* Sparks at 3:22-27; *see also* Sparks at Abstract; *see also* Sparks at 2:20-25; *see also* Sparks at 3:3-9; *see also* Sparks at 3:14-21; *see also* Sparks at 3:37-43; *see also* Sparks at 4:38-40 ("a closed-loop servo control system is employed. The control system is normally used to provide high optical coupling efficiency"). Furthermore, the components used for performing the functions of spectral monitoring and feedback servo-control of the mirrors

are the same or analogous to the components used for channel switching functions. It would have been obvious for a POSITA to try to use these common components for both the functions of optical channel switching and for power control in a feedback loop, as there would have been a reasonable expectation of success and a common sense advantage in reducing cost and size of the system by reducing the number of components needed to perform both functions.

(ii) *Alignment mirrors*

1966. To the extent Bouevitch did not teach alignment mirrors, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	Claim(s)	Limitations
'905 Patent	29	". . . alignment mirrors . . . ."
'906 Patent	72	". . . an array of collimator-alignment mirrors . . . ."
'906 Patent	92	". . . an array of collimator-alignment mirrors . . . ."
'906 Patent	100-f	". . . a one-dimensional array of collimator-alignment mirrors . . . ."
'906 Patent	118	". . . an array of collimator-alignment mirrors . . . ."

1967. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add an array of mirrors in communication with collimator input and output ports to Bouevitch (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Bouevitch (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1968. A POSITA also would have combined other prior art references with Bouevitch, incorporating these limitations into Bouevitch. For example, as discussed above in Section IX.1.a, Tew ’640, taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference.

1969. A POSITA would have been motivated to combine Bouevitch (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew ’640, Sparks, and/or Smith to include these limitations for at least the following reasons. The prior art recognized “two principal types of alignment or mismatch,” namely, “positional mismatch” or “angular mismatch” (*see, e.g.*, Smith at 17:24–52), and a person of ordinary skill in the art would have been motivated to combine or modify the prior art to either account for this alignment or mismatch or to intentionally use this alignment or mismatch (*see, e.g.*, *id.* at 18:54–57; Sparks, Abstract) to, for example, implement dynamic feedback control or dynamically control power levels. Additionally, Tew ’640 discloses mirrors that can be shaped to help focus the light form one fiber or mirror to the next, thus simplifying the alignment of the OADM. For example, "in some applications using a spherical or aspherical curved deflecting surface helps to focus the light from one fiber or mirror to the next, or helps to simplify alignment of the OADM during assembly." Tew ’640 at 11:27-41; *see also* Provisional Application No. 60/236,532 at 21:11-19.

(iii) *Signals are not transmitted through a circulator*

1970. To the extent Bouevitch did not teach signals not being transmitted through a circulator, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	Claim(s)	Limitations
’905 Patent	37	“. . . none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator”
’905 Patent	48	“. . . none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator”
’905 Patent	50	“. . . none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator”
’906 Patent	88	“. . . neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator.”
’906 Patent	99	“. . . neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator”
’906 Patent	106	“. . . neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator”
’906 Patent	132	“. . . neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator.”

1971. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add that signals are not transmitted through a circulator to Bouevitch (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Bouevitch (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1972. A POSITA also would have combined other prior art references with Bouevitch, incorporating these limitations into Bouevitch. For example, as discussed above in Section IX.1.a, Tew ’640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I

incorporate that analysis by reference. As another example, as discussed above in Section IX.1.c, Solgaard taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.f, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.i, Tew '070 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.l, Kramer these limitations, and I incorporate that analysis by reference.

1973. A POSITA would have been motivated to combine Bouevitch (alone or in combination with the common knowledge of a POSITA and/or other prior art) with 'Tew 640, Smith, Solgaard, Lalonde, Sparks, Rose, Tew '070, and/or Kramer to include these limitations for at least the following reasons. The prior art recognized that input and output fibers (including, for example, add and drop fibers) could be "arranged in, a variety of ways," including placing them side by side, placing one over or under another, and using the same fiber for different paths, the latter arrangement using equipment such as an optical circulator to separate signals." *See, e.g.*, Solgaard at 9:14–20. A person of ordinary skill would have been motivated to combine or modify the prior art to accomplish any such fiber arrangements, including, for example, taking a system that uses the same fiber for different paths with an optical circulator, adding fibers (if necessary), separating the paths onto different fibers (arranged, for example, side by side), and removing any optical circulators. *See, e.g.*, Kramer at 34:20-28. As another example, the prior art recognized that, while circulators could be used in

various systems, they could be replaced by, for example, "[a]ny light separation device[.]" *See, e.g.*, Tew '070, ¶ 39. Such a light separation device included "a diffraction grating, prism, or other optical component." *See, e.g.*, *id.*, ¶ 40. The prior art also recognized that circulators were "bulky" and "costly." *See, e.g.*, Bouevitch at 13:5–6; U.S. Patent No. 5,960,133 at 4:3-4 ("Circulators are expensive and add loss.") *See also, e.g.,* Kramer at 33:56-34:2 and 34:20-28. Accordingly, a person of ordinary skill in the art would have been motivated to combine or modify prior art disclosures to replace or eliminate circulators and, if necessary, replace them with more ideal components such as, for example, other light separation devices.

(iv) *Fiber collimators*

1974. To the extent Bouevitch did not teach fiber collimators, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'905 Patent	39	". . . fiber collimator input port, the one or more other fiber collimator ports . . . ."
'906 Patent	68-a	"multiple fiber collimators . . . ."
'906 Patent	89-a	"multiple fiber collimators . . . ."
'906 Patent	100-a	"an array of fiber collimators . . . ."
'906 Patent	115-a	"an array of fiber collimators . . . ."
'906 Patent	126-a	"multiple auxiliary fiber collimators . . . ."
'906 Patent	131	". . . said fiber collimator pass-through port constitutes one of said fiber collimator auxiliary input ports . . . ."
'906 Patent	133-a	". . . a fiber collimator input port"

1975. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of

the Art). Accordingly, a POSITA would not need any motivation to add fiber collimators to Bouevitch (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Bouevitch (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1976. A POSITA also would have combined other prior art references with Bouevitch, incorporating these limitations into Bouevitch. For example, as discussed above in Section IX.1.a, Tew ’640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.c Solgaard taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.h, Tew ’520 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.l, Kramer these limitations, and I incorporate that analysis by reference.

1977. A POSITA would have been motivated to combine Bouevitch (alone or in combination with the common knowledge of a POSITA and/or other prior art) with ’Tew 640, Smith, Solgaard, Lalonde, Sparks, Rose, Tew ’520, and/or Kramer to include these limitations for at least the following reasons. The prior art also recognized that holding an optical fiber in a

ferrule with a collimator lens, such as a self-focusing gradient index (GRIN) lens (what the Asserted Patents arguably identify as at least one example of "a fiber collimator" *see, e.g.*, '905 Patent at 9:34–38) "simplifies handling of the optical fibers." *See, e.g.*, Tew '520 at 5:45–50. The prior art similarly recognized that "[c]ollimated light is desired due to the typically small mirror tilt angle provided by common micromirror devices." *See, e.g.*, *id.* at 5:49–51. A person of ordinary skill would have therefore been motivated to combine or modify the prior art to include such fiber collimators (replacing components rendered unnecessary, duplicative, and/or obsolete by such fiber collimators), and to include such fiber collimators specifically in the form of "fiber collimator ports" or fiber collimators "serving as" ports (replacing components rendered unnecessary, duplicative, and/or obsolete by such fiber collimator ports, including other types of ports or components using other types of ports). As another example, the prior art also recognized that input and output fibers (including, for example, add and drop fibers) could be "arranged in, a variety of ways," including placing them side by side, placing one over or under another, and using the same fiber for different paths, the latter arrangement using equipment such as an optical circulator to separate signals." *See, e.g.*, Solgaard at 9:14–20. A person of ordinary skill would have been motivated to combine or modify the prior art to accomplish any such fiber arrangements, including, for example, taking a system that uses the same fiber for different paths with an optical circulator, adding fibers (if necessary), separating the paths onto different fibers (arranged, for example, side by side), and removing any optical circulators. *See, e.g.*, Kramer at 34:20-28.

(v) *Pivoting about two axes*

1978. To the extent Bouevitch did not teach pivoting about two axes, this limitation would have been within the common knowledge of a POSITA and were disclosed in the prior art. This specific limitation is found in the following claims:

Patent	**Claim(s)**	**Limitations**
’906 Patent	68-d	“. . . said channel micromirrors being pivotal about two axes . . . .”
’906 Patent	115-e	“. . . said channel micromirrors being pivotal about two axes . . . .”
’906 Patent	133-d	“dynamically and continuously controlling said beam-deflecting elements in two dimensions . . . .”

1979. As an initial matter, this limitation was within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add pivoting about two axes to Bouevitch (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Bouevitch (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1980. A POSITA also would have combined other prior art references with Bouevitch, incorporating these limitations into Bouevitch. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference.

1981. A POSITA would have been motivated to combine Bouevitch (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Lalonde, and/or Smith to include these limitations for at least the following reasons. The prior art recognized that it was “desirable to integrate” into optical networks systems that utilized arrays of mirrors that were tiltable about two axes, at least so as to dynamically control power

levels. *See, e.g.*, Smith at 6:51–61 (describing U.S. Patent No. 6,263,123 to Bishop et al.). Lalonde also describes `3-D MEMS` devices have emerged as the photonic switch technology of choice for large fabric switches. 3-D MEMS is a term used by the Applicant for a mirror mounted on a frame that can be ***rotated along two axes***, giving it four degrees of freedom. The 3-D MEMS devices are arranged preferably in a matrix, which comprises besides the mirrors a control system for positioning the mirrors independently." *See* Lalonde at 2:30-37 (emphasis added); *see also id.* at 3:16-18, 4:61-64, 5:34-57, 6:9-35, 6:54-66, 7:13-42, 7:65-8:14, 8:46-60, Figs. 3A-4B. A would have not only been motivated to combine or modify the prior art so as to dynamically control power levels and implement feedback control but would have been specifically been motivated to combine or modify the prior art to incorporate arrays of mirrors tiltable about two axes to do so. Sparks also discloses light that can be reflected off a movable mirror which precisely directs the beam in two axes. Sparks at 4:15-23; *see also* Sparks at FIG. 1. A POSITA would have been motivated to modify Bouevitch because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references.

(vi) *Silicon micromirrors*

1982. To the extent Bouevitch did not teach silicon micromirrors, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	79	". . . each channel micromirror is a silicon micromachined mirror"
'906 Patent	96	". . . each channel micromirror is a silicon micromachined mirror"

Patent	Claim(s)	Limitations
’906 Patent	122	“. . . each channel micromirror is a silicon micromachined mirror”
’906 Patent	129	“. . . each auxiliary channel micromirror is a silicon micromachined mirror”
’906 Patent	139	“. . . said beam-deflecting elements comprise an array of silicon micromachined mirrors”

1983. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add silicon micromirrors to Bouevitch (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Bouevitch (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1984. A POSITA also would have combined other prior art references with Bouevitch, incorporating these limitations into Bouevitch. For example, as discussed above in Section IX.1.a, Tew ’640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.c, Solgaard taught these limitations, and I incorporate that analysis by reference.

1985. A POSITA would have been motivated to combine Rose (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew ’640, Smith, and/or Solgaard to include these limitations for at least the following reasons. A POSITA would have

been motivated to combine Lalonde (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew ’640, Smith, and/or Solgaard, to include these limitations for at least the following reasons. A POSITA would have been motivated to modify Lalonde because it was within such person’s knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references. In addition, it was common knowledge in the prior art to use silicon for micromirrors and a POSITA would have been motivated to use such a material. Solheim Tr. at 42:21-43:3 (“Q And then, back in 2000, what material would MEMS mirrors typically be manufactured from? MR. BECKER: Object. Form. THE WITNESS: Typically they would be manufactured from -- from silicon, and would use some sort of metal coating to create the traces and may use either polished silicon or metal as the mirror -- mirrored surface.”). Tew ’640 also discloses silicon micromirrors. Tew ’640 also discloses “[t]he micromirror 300 is fabricated on a semiconductor, typically silicon, substrate 304.” Tew ’640 at 5:19-32; see also Provisional Application No. 60/236,532 at 10:3-11. 167. Rose discloses the switches and the reflectors can be as a MEMS device having micromachined deformable mirrors. “An embodiment of a reflective switch 1516 that may be used in the embodiment of OADM of in FIGS. 15 and 16 is illustrated in FIGS. 17 A and 17B. The switch 1516 may be a MEMs device having a reflecting surface 1518 that can be moved between at least two positions. The switch may be, for example, a linear MMDM (micromachined deformable mirror) supplied by Flexible Optics BV, Netherlands.” Rose at 14:55-61. A POSITA would understand the reflectors could be silicon MEMS micromachined mirrors since these types of devices were known in the art and commercially available.

(vii) *Optical sensors*

1986. To the extent Bouevitch did not teach "wherein each fiber collimator output port carries a single one of said spectral channels" and "one or more optical sensors, optically coupled to said fiber collimator output ports," these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	86	". . . wherein each fiber collimator output port carries a single one of said spectral channels."
'906 Patent	87	". . . one or more optical sensors, optically coupled to said fiber collimator output ports."

1987. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add "wherein each fiber collimator output port carries a single one of said spectral channels" and "one or more optical sensors, optically coupled to said fiber collimator output ports" to Bouevitch (alone or in combination with other prior art) to arrive at the claimed invention. A POSITA would have been motivated to use ordinary creativity to add the common knowledge of a POSITA to Bouevitch (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1988. A POSITA also would have combined other prior art references with Bouevitch, incorporating these limitations into Bouevitch. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate

that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught the "wherein each fiber collimator output port carries a single one of said spectral channels" limitation, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.a, Tew '640 taught the "wherein each fiber collimator output port carries a single one of said spectral channels" limitation, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught the "wherein each fiber collimator output port carries a single one of said spectral channels" limitation, and I incorporate that analysis by reference.

1989. A POSITA would have been motivated to combine Bouevitch (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Smith, Lalonde, Tew '640, and/or Rose, to include these limitations for at least the following reasons. A POSITA would have recognized based on the problems to be solved and the teachings of the prior art that each output port carries a single spectral channel and that sensors were often coupled to output ports. For example, Smith describes "an optical monitoring system [that] is incorporated by fusing two monitoring fibers 210, 212 to the output fibers 166, 168 to form Y-couplers 214, 216 coupling about 10% of the optical output power to the monitoring fibers 212, 216." *See* Smith at 13:7-20 (emphasis added); see also id. at 9:7-46, 11:39-46, 14:16-32, Figs. 8, 11-13; *see also* Smith Prov. at 11:2-13, Fig. 4. As another Example, Sparks discloses "measuring the optical signal power comprises at least one of measuring the input optical signal power and measuring the output optical signal power." Sparks at 2:44-47; *see also* Sparks at 2:39-43; Sparks at 2:51-65; Sparks at 2:66-3:2; Sparks at 3:34-36. A POSITA would have been motivated to modify Bouevitch because it was within such person's knowledge to

combine or modify the prior art to include various features omitted from any single prior art reference or combination of references.

(viii) *Auxiliary components*

1990. To the extent Bouevitch did not teach auxiliary components, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	Claim(s)	Limitations
'906 Patent	126-pre	". . . an auxiliary wavelength-separating-routing apparatus . . . ."
'906 Patent	126-a	"multiple auxiliary fiber collimators . . . ."
'906 Patent	126-c	"an auxiliary wavelength-separator"
'906 Patent	126-e	"a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors"
'906 Patent	129	". . . auxiliary channel micromirror . . . ."

1991. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add auxiliary components to Bouevitch (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Bouevitch (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1992. A POSITA also would have combined other prior art references with Bouevitch, incorporating these limitations into Bouevitch. For example, as discussed above in Section IX.1.a, Tew '640 these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.c, Solgaard taught these limitations, and I incorporate that analysis by reference.

1993. A POSITA would have been motivated to combine Bouevitch (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew '640, Sparks, Smith, Lalonde, and/or Solgaard to include these limitations for at least the following reasons. For example, Tew '640 discloses multiple input fibers that can serve as auxiliary wavelength separators: "at the same time the light beam 420 from the "in" fiber 402 is being dropped, another light beam 434 is provided to the first output fiber 406. The second light beam 434 exits the second input fiber 404, the "add" fiber."" Tew '640 at 8:65-9:1; *see also* Provisional Application No. 60/236,532 at 17:1-3. 223.227. Sparks also discloses having multiple inputs and multiple outputs, which can each have focusing lenses coupled to the input fibers and the output fibers, and which can each have an input fiber that inputs a diffracted signal. "Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals." Sparks at

2:66-3:2; *see also* Sparks at 3:3-9. A POSITA would be motivated to combine or modify the prior art to have an auxiliary wavelength separating-routing apparatus by partially and then fully demultiplexing signals, because "partial demultiplexing characteristic of an arrayed waveguide router (AWR) can, advantageously, be combined with a free-space optical router to fully demultiplex an input WDM signal.

g) Obviousness Based on Rose

1994. In my opinion, before accounting for secondary considerations, a POSITA would find the Asserted Claims obvious in view of Rose and the foregoing, alone or in combination:

- The knowledge of a POSITA;
- Tew '640;
- Smith;
- Solgaard;
- Lalonde
- Sparks;
- Bouevitch;
- Tew '520;
- Tew '070;
- Carr;
- Raj;
- Kramer; and
- Yuan.

I analyzed the scope and content of Rose above in Section IX.1.g, and I incorporate that analysis by reference. Below, I have selected certain example limitations from the Asserted Claims and

explained why it would have been obvious to combine Rose (alone or in combination with the common knowledge of a POSITA and/or other prior art) to include these limitations. However, to the extent any limitations are absent from Rose that are not specifically addressed below, such limitations would have been within the common knowledge of a POSITA, and POSITA would have been motivated to combine Rose (alone or in combination with the common knowledge of a POSITA and/or other prior art) with the other prior art references discussed throughout this report to include those limitations.

(i) *Continuously controllable in two dimensions*

1995. To the extent Rose did not teach continuously controllable in two dimensions, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'905 Patent	23-e	". . . each of said elements being individually and continuously controllable in two dimensions . . . ."
'905 Patent	47-e	". . . each of said elements being individually and continuously controllable in two dimensions . . . ."
'905 Patent	49-e	". . . each of said elements being individually and continuously controllable in two dimensions . . . ."
'905 Patent	51-c	"controlling dynamically and continuously said beam-deflecting elements in two dimensions . . . ."
'905 Patent	52	". . . controlling dynamically and continuously said other beam-deflecting elements . . . ."
'906 Patent	68-d	". . . said channel micromirrors being pivotal about two axes and being individually and continuously controllable . . . ."
'906 Patent	89-d	". . . said channel micromirrors being individually controllable . . . ."

Patent	**Claim(s)**	**Limitations**
’906 Patent	100-e	“. . . said channel micromirrors being individually and continuously controllable . . . .”
’906 Patent	115-e	“. . . said channel micromirrors being pivotal about two axes and being individually and continuously controllable . . . .”
’906 Patent	133-d	“. . . dynamically and continuously controlling said beam-deflecting elements in two dimensions . . . .”

1996. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add continuously controllable in two dimensions to Rose (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Rose (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

1997. A POSITA also would have combined other prior art references with Rose, incorporating these limitations into Rose. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference.

1998. A POSITA would have been motivated to combine Rose (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Lalonde, and/or Smith to include these limitations for at least the following reasons. The prior art recognized that it was “desirable to integrate” into optical networks systems that utilized arrays of mirrors

that were tiltable about two axes, at least so as to dynamically control power levels. *See, e.g.*, Smith at 6:51–61 (describing U.S. Patent No. 6,263,123 to Bishop et al.). Lalonde also describes `3-D MEMS` devices have emerged as the photonic switch technology of choice for large fabric switches. 3-D MEMS is a term used by the Applicant for a mirror mounted on a frame that can be ***rotated along two axes***, giving it four degrees of freedom. The 3-D MEMS devices are arranged preferably in a matrix, which comprises besides the mirrors a control system for positioning the mirrors independently." *See* Lalonde at 2:30-37 (emphasis added); *see also id.* at 3:16-18, 4:61-64, 5:34-57, 6:9-35, 6:54-66, 7:13-42, 7:65-8:14, 8:46-60, Figs. 3A-4B. A POSITA would have not only been motivated to combine or modify the prior art so as to dynamically control power levels and implement feedback control but would have been specifically been motivated to combine or modify the prior art to incorporate arrays of mirrors tiltable about two axes to do so. Sparks also discloses light that can be reflected off a movable mirror which precisely directs the beam in two axes. Sparks at 4:15-23; *see also* Sparks at FIG. 1. A POSITA would have been motivated to modify Solgaard because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references.

(ii) *Alignment mirrors*

1999. To the extent Rose did not teach alignment mirrors, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'905 Patent	29	". . . alignment mirrors . . . ."
'906 Patent	72	". . . an array of collimator-alignment mirrors . . . ."

Patent	**Claim(s)**	**Limitations**
’906 Patent	92	“. . . an array of collimator-alignment mirrors . . . .”
’906 Patent	100-f	“. . . a one-dimensional array of collimator-alignment mirrors . . . .”
’906 Patent	118	“. . . an array of collimator-alignment mirrors . . . .”

2000. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add an array of mirrors in communication with collimator input and output ports to Rose (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Rose (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

2001. A POSITA also would have combined other prior art references with Rose, incorporating these limitations into Rose. For example, as discussed above in Section IX.1.a, Tew ’640, taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference.

2002. A POSITA would have been motivated to combine Rose (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew ’640, Sparks, and/or Smith to include these limitations for at least the following reasons. The prior art recognized “two principal types of alignment or mismatch,” namely, “positional mismatch” or “angular mismatch” (*see, e.g.*, Smith at 17:24–52), and a person of ordinary skill in the art would have been motivated to combine or modify the prior art to either account for this alignment or

mismatch or to intentionally use this alignment or mismatch (*see, e.g.*, *id.* at 18:54–57; Sparks, Abstract) to, for example, implement dynamic feedback control or dynamically control power levels. Additionally, Tew ’640 discloses mirrors that can be shaped to help focus the light form one fiber or mirror to the next, thus simplifying the alignment of the OADM. For example, "in some applications using a spherical or aspherical curved deflecting surface helps to focus the light from one fiber or mirror to the next, or helps to simplify alignment of the OADM during assembly." Tew ’640 at 11:27-41; *see also* Provisional Application No. 60/236,532 at 21:11-19.

(iii) *Silicon micromirrors*

2003. To the extent Rose did not teach silicon micromirrors, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
’906 Patent	79	“. . . each channel micromirror is a silicon micromachined mirror”
’906 Patent	96	“. . . each channel micromirror is a silicon micromachined mirror”
’906 Patent	122	“. . . each channel micromirror is a silicon micromachined mirror”
’906 Patent	129	“. . . each auxiliary channel micromirror is a silicon micromachined mirror”
’906 Patent	139	“. . . said beam-deflecting elements comprise an array of silicon micromachined mirrors”

2004. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add silicon micromirrors to Rose (alone or in combination with other prior art) to each other to arrive at the claimed

invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Rose (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

2005. A POSITA also would have combined other prior art references with Rose, incorporating these limitations into Rose. For example, as discussed above in Section IX.1.a, Tew ’640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.c, Solgaard taught these limitations, and I incorporate that analysis by reference.

2006. A POSITA would have been motivated to combine Rose (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew ’640, Smith, and/or Solgaard to include these limitations for at least the following reasons. A POSITA would have been motivated to combine Lalonde (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew ’640, Smith, and/or Solgaard, to include these limitations for at least the following reasons. A POSITA would have been motivated to modify Lalonde because it was within such person’s knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references. In addition, it was common knowledge in the prior art to use silicon for micromirrors and a POSITA would have been motivated to use such a material. Solheim Tr. at 42:21-43:3 (“Q And then, back in 2000, what material would MEMS mirrors typically be manufactured from? MR. BECKER: Object. Form. THE WITNESS: Typically they would be manufactured from -- from silicon, and would use some sort of metal coating to create the traces and may use either polished silicon or metal as the mirror -- mirrored surface.”). Tew ’640 also

discloses silicon micromirrors. Tew ’640 also discloses “[t]he micromirror 300 is fabricated on a semiconductor, typically silicon, substrate 304.” Tew ’640 at 5:19-32; *see also* Provisional Application No. 60/236,532 at 10:3-11.

(iv) *Quarter-wave plate*

2007. To the extent Rose did not teach quarter-wave plates, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
’906 Patent	85	“. . . a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors.”
’906 Patent	125	“. . . a quarter-wave plate optically interposed between said wavelength-separator and said channel micromirrors.”

2008. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add quarter-wave plates to Rose (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Rose (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

2009. A POSITA also would have combined other prior art references with Rose, incorporating these limitations into Rose. For example, as discussed above in Section IX.1.c, ‘'Solgaard taught these limitations, and I incorporate that analysis by reference. As another

example, as discussed above in Section IX.1.f, Bouevitch taught these limitations, and I incorporate that analysis by reference.

2010. A POSITA would have been motivated to combine Rose (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Solgaard and/or Bouevitch to include these limitations for at least the following reasons. The prior art also recognized that it was "well understood by those in the art" that "wave plates" (such as quarter- or half-wave plates) could be inserted, for example, "so as to substantially eliminate polarization dependence within the switch." *See, e.g.*, Smith at 5:39–42; *see also, e.g.*, Solgaard at 8:18–20; Bouevitch at 5:49–60, 7:23–44; Rose at 19:56-59. Bouevitch discloses a reflector on a MEMS device. "FIG. 5 is a schematic diagram of another embodiment of the modifying means 150 including a micro electromechanical switch (MEMS) 155, which is particularly useful when the device is used as a DGE … After passing through the quarter waveplate 157, the beam of light becomes circularly polarized and is incident on a predetermined reflector of the MEMS array 155." Bouevitch at 7:23-34. To the extent Bouevitch does not teach "micromachined mirrors[,]" these limitations would have been within the common knowledge of a POSITA and were taught by other prior art references discussed throughout this report.

(v) *Optical sensors*

2011. To the extent Rose did not teach optical sensors, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	87	". . . one or more optical sensors, optically coupled to said fiber collimator output ports."

2012. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add one or more sensors optically coupled to fiber collimator ports to Rose (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Rose (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

2013. A POSITA also would have combined other prior art references with Rose, incorporating these limitations into Rose. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference.

2014. A POSITA would have been motivated to combine Tew ’640 (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks and/or Smith to include these limitations for at least the following reasons. A POSITA would have recognized based on the problems to be solved and the teachings of the prior art that each output port carries a single spectral channel and that sensors were often coupled to output ports. For example, Smith describes “an optical monitoring system [that] is incorporated by fusing two monitoring fibers 210, 212 to the output fibers 166, 168 to form Y-couplers 214, 216 coupling about 10% of the optical output power to the monitoring fibers 212, 216.” *See* Smith at 13:7-20 (emphasis added); *see also id.* at 9:7-46, 11:39-46, 14:16-32, Figs. 8, 11-13; *see also* Smith Prov. at 11:2-13, Fig. 4. As another Example, Sparks discloses “measuring the optical signal power comprises at least one of measuring the input optical signal power and measuring the

output optical signal power." Sparks at 2:44-47; *see also* Sparks at 2:39-43; Sparks at 2:51-65; Sparks at 2:66-3:2; Sparks at 3:34-36. A POSITA would have been motivated to modify Solgaard because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references.

(vi) *One-dimensional array of collimator-alignment mirrors*

2015. To the extent Rose did not teach a one-dimensional array of collimator-alignment mirrors, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	100-f	". . . a one-dimensional array of collimator-alignment mirrors . . . ."

2016. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add a one dimensional array of mirrors to Rose (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Rose (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

2017. A POSITA also would have combined other prior art references with Rose, incorporating these limitations into Rose. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.g, Rose taught these limitations, and I incorporate

that analysis by reference. As another example, as discussed above in Section IX.1.k, Raj taught these limitations, and I incorporate that analysis by reference.

2018. A POSITA would have been motivated to combine Tew '640 (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Rose, and/or Raj to include these limitations for at least the following reasons. A POSITA would be motivated to combine or modify the prior art to have a one-dimensional array of input and output ports such that "the ultimate disposition of each channel on each fiber … may be controlled by the MEMS element … to specifically direct or route each input channel to a particular output fiber" with "relatively high precision" and "compact arrangement." See, e.g., Raj at 4:45-52. A POSITA would have recognized that a one-dimensional array of mirrors positioned as a row or column was a known arrangement commonly used in optical systems. Furthermore, Sparks discloses an array of modules having inputs and outputs. "By having two arrays of such modules, optical signals coming in from a first array may be directed into any of the output fibres of the second array." Sparks at 4:33-35; *see also* Rose at FIG. 12B (showing mirrors 220, 1122 in a one dimensional array). A POSITA would have recognized that a one-dimensional array of mirrors positioned as a row or column was a known arrangement commonly used in optical systems.

(vii) *Pass-through port*

2019. To the extent Rose did not teach a pass-through port, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	115-b	". . . a pass-through port"

Patent	**Claim(s)**	**Limitations**
’906 Patent	115-e	“. . . pass-through port”
’906 Patent	126-e	“. . . pass-through port”
’906 Patent	131	“. . . pass-through port constitutes one of said fiber collimator auxiliary input ports”
’906 Patent	133	“. . . one or more pass-through spectral channels”

2020. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add a pass-through port to Rose (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Rose (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

2021. A POSITA also would have combined other prior art references with Rose, incorporating these limitations into Rose. For example, as discussed above in Section IX.1.a, Tew ’640 taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.f, Bouevitch taught these limitations, and I incorporate that analysis by reference.

2022. A POSITA would have been motivated to combine Rose (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew ’640, Smith, and/or Bouevitch to include these limitations for at least the following reasons. A POSITA would have recognized that pass-through ports and drop ports were commonly known components. For example, Tew ’640 discloses a pass-through port that can be used to re-transmit a signal:

"[w]hen the switch is in a first position, the signal on the first input 110 is passed through to the first output 112 and retransmitted." Tew '640 at 4:30-42; *see also* Provisional Application No. 60/236,532 at 8:12-19; Tew '640 at FIG. 1; Provisional Application No. 60/236,532 at FIG. 1. As such, the pass-through port can essentially serve as an auxiliary input port. A POSITA would have been motivated to modify Rose because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references. Bouevitch discloses a passthrough port receiving and propagating light. Referring to FIG. 11, reflector 51 is orientated such that the sub-beam of light corresponding to λ1 incident thereon, is reflected back along the same optical path to the lens 90, passes through port 85 again, and propagates to port 2 of circulator 80a where it is circulated to port 3. Reflector 52, however, is orientated such that the sub-beam of light corresponding to λ2 is reflected back along a different optical path. Accordingly, the dropped signal corresponding to wavelength λ2 is returned to the lens 90, passes through port 87, propagates to port 2 of the second circulator 80b, and is circulated to port 3." Bouevitch at 14:55-65; *see also* Bouevitch at 6:20-25 (that the modifying means of the ROADM allows a light beam to pass through unchanged).

(viii) *Auxiliary components*

2023. To the extent Rose did not teach auxiliary components, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	**Claim(s)**	**Limitations**
'906 Patent	126-pre	". . . an auxiliary wavelength-separating-routing apparatus . . . ."
'906 Patent	126-a	"multiple auxiliary fiber collimators . . . ."

Patent	Claim(s)	Limitations
’906 Patent	126-c	“an auxiliary wavelength-separator”
’906 Patent	126-e	“a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors”
’906 Patent	129	“. . . auxiliary channel micromirror . . . .”

2024. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add auxiliary components to Rose (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Rose (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

2025. A POSITA also would have combined other prior art references with Rose, incorporating these limitations into Rose. For example, as discussed above in Section IX.1.a, Tew ’640 these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.c, Solgaard taught these limitations, and I incorporate that analysis by reference.

2026. A POSITA would have been motivated to combine Rose (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Tew ’640, Sparks, Smith, Lalonde, and/or Solgaard to include these limitations for at least the following reasons. For example, Tew ‘640 discloses multiple input fibers that can serve as auxiliary wavelength separators: “at the same time the light beam 420 from the "in" fiber 402 is being dropped, another light beam 434 is provided to the first output fiber 406. The second light beam 434 exits the second input fiber 404, the "add" fiber."” Tew ’640 at 8:65-9:1; *see also* Provisional Application No. 60/236,532 at 17:1-3. 223.227. Sparks also discloses having multiple inputs and multiple outputs, which can each have focusing lenses coupled to the input fibers and the output fibers, and which can each have an input fiber that inputs a diffracted signal. “Preferably, said optical switch comprises at least two inputs and two outputs arranged to switch the optical beam path of different wavelength optical signals, the method comprising misaligning respective optical beam paths so as to achieve a predetermined ratio of output optical power between at least any two of said different wavelength optical signals.” Sparks at 2:66-3:2; *see also* Sparks at 3:3-9. A POSITA would be motivated to combine or modify the prior art to have an auxiliary wavelength separating-routing apparatus by partially and then fully demultiplexing signals, because “partial demultiplexing characteristic of an arrayed waveguide router (AWR) can, advantageously, be combined with a free-space optical router to fully demultiplex an input WDM signal.

(ix) *Pivotable micromirrors*

2027. To the extent Rose did not teach pivotable micromirrors, these limitations would have been within the common knowledge of a POSITA and were disclosed in the prior art. These specific limitations are found in the following claims:

Patent	Claim(s)	Limitations
’906 Patent	68-d	“. . . channel micromirrors being pivotal about two axes . . . .”
’906 Patent	115-e	“. . . channel micromirrors being pivotal about two axes . . . .”
’906 Patent	127	“. . . channel micromirrors are individually pivotable”

2028. As an initial matter, these limitations were within the common knowledge of a POSITA, as explained above in Section VII (discussing the Technological Background State of the Art). Accordingly, a POSITA would not need any motivation to add pivotable micromirrors to Rose (alone or in combination with other prior art) to each other to arrive at the claimed invention. A POSITA could have and would have simply used ordinary creativity to add their common knowledge to Rose (alone or in combination with other prior art) like pieces of a puzzle to arrive at the Asserted Claims.

2029. A POSITA also would have combined other prior art references with Rose, incorporating these limitations into Rose. For example, as discussed above in Section IX.1.e, Sparks taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.d, Lalonde taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.b, Smith taught these limitations, and I incorporate that analysis by reference. As another example, as discussed above in Section IX.1.a, Tew ’640 taught these limitations, and I incorporate that analysis by reference.

2030. A POSITA would have been motivated to combine Tew ’640 (alone or in combination with the common knowledge of a POSITA and/or other prior art) with Sparks, Lalonde, and/or Smith to include these limitations for at least the following reasons. The prior

art recognized that it was "desirable to integrate" into optical networks systems that utilized arrays of mirrors that were tiltable about two axes, at least so as to dynamically control power levels. *See, e.g.*, Smith at 6:51–61 (describing U.S. Patent No. 6,263,123 to Bishop et al.). Lalonde also describes `3-D MEMS` devices have emerged as the photonic switch technology of choice for large fabric switches. 3-D MEMS is a term used by the Applicant for a mirror mounted on a frame that can be *rotated along two axes*, giving it four degrees of freedom. The 3-D MEMS devices are arranged preferably in a matrix, which comprises besides the mirrors a control system for positioning the mirrors independently." *See* Lalonde at 2:30-37 (emphasis added); *see also id.* at 3:16-18, 4:61-64, 5:34-57, 6:9-35, 6:54-66, 7:13-42, 7:65-8:14, 8:46-60, Figs. 3A-4B. A person of ordinary skill in the art would have not only been motivated to combine or modify the prior art so as to dynamically control power levels and implement feedback control but would have been specifically been motivated to combine or modify the prior art to incorporate arrays of mirrors tiltable about two axes to do so. Sparks also discloses light that can be reflected off a movable mirror which precisely directs the beam in two axes. Sparks at 4:15-23; see also Sparks at FIG. 1. Tew '640 also discloses discrete mirrors being free that are operable to pivot about an axis. For example, "the mirror is free to rotate about the axis formed by the torsion hinge. Electrostatic attraction between an address electrode 310 and a deflectable rigid member, which in effect form the two plates of an air gap capacitor, is used to rotate the mirror structure. Depending on the design of the micromirror device, the deflectable rigid member is the torsion beam yoke 314, the beam or mirror 302, a beam attached directly to the torsion hinges, or a combination thereof. The upper address electrodes 324 also electrostatically attract the deflectable rigid member." Tew '640 at 7:28-38; *see also* Provisional Application No. 60/236,532 at 14:1-7. Further, Tew '640 further describes, and Figures 4-8

detail that the discrete mirrors as being able to move independent of one another. "The micromirror array 414 of FIG. 4 includes four discrete mirrors 416. Each of the mirrors 422, 426, 428, 430 is operable to tilt clockwise or counterclockwise about an axis perpendicular to the plane of FIG. 4." Tew '640 at 8:32-35.

3. Secondary Considerations

2031. I understand that "secondary considerations" or "objective indicia," when present, must be considered when evaluating whether a patent claim is obvious. I understand that such "secondary considerations" or "objective indicia" include the following:

- a long-felt but unmet need in the prior art that was satisfied by the claimed invention;
- commercial success of processes covered by the patent as a result of the merits of the claimed invention, rather than the result of design needs, market pressure, advertising, or similar activities;
- unexpected results achieved by the invention;
- praise of the invention by others skilled in the art;
- the taking of licenses under the patent by others;
- whether others had tried and failed to make the invention;
- whether persons of ordinary skill in the art expressed surprise or disbelief regarding the invention;
- whether the inventor proceeded contrary to accepted wisdom;
- independent contemporaneous invention by others; and
- deliberate copying of the invention.

As an initial matter, setting aside any allegations specifically made by Capella, I am not aware of any such evidence of such "secondary considerations" or "objective indicia" that would indicate the Asserted Claims are non-obvious.

2032. It is my understanding that it is Capella's burden to produce evidence of secondary considerations. I understand that, in Interrogatory No. 8, Infinera asked Capella to "Identify and describe all factual and legal bases that support or contradict any secondary indicia of nonobvious for any Asserted Claim." Plaintiff Capella Photonics, Inc.'s Objections and Supplemental Responses to Defendants' First Set of Interrogatories (Nos. 1–20) at 8 (January 5, 2021). Capella provided the following supplemental response:

> Subject to the forgoing objections, based on the patent laws of the United States, Title 35 of the U.S. Code, Capella asserts that the patents were recently issued by the United States Patent Office after a finding that they complied with all patent laws. They are presumed valid and that presumption applies to the issue of obviousness. The claimed inventions have enjoyed tremendous commercial success as demonstrated by the widespread adoption in the industry, including by Cisco, Ciena, Infinera and Fujitsu. The inventions supplied a long felt need for a compact, scalable, all-optical switching device with power control as set forth in the Background section of the patents. The industry including Infinera has since adopted and copied Capella's solution.

Id. at 9. Similarly, I understand that, in Interrogatory No. 4, FNC asked Capella the following:

> With respect to any objective indicia or secondary considerations that You contend are relevant in determining the issue of obviousness of the alleged inventions described in the Asserted Claims under 35 U.S.C. § 103 (including commercial success, long-felt need, failed attempts of others to solve a problem, initial skepticism, industry recognition and praise for patented products, unexpected results or properties, licenses, and copying and imitation by others), list each such objective indicia or secondary consideration and describe all of the facts, circumstances and legal bases that You believe establish, support, contradict, or otherwise relate to such contention, and identify each document that supports Your contention and each person having knowledge of those facts.

Plaintiff Capella Photonics, Inc.'s Objections and Responses to Defendants' First Set of Interrogatories (Nos. 1–11) at 9 (January 12, 2021). Capella provided the following response:

> Subject to the forgoing objections, based on the patent laws of the United States, Title 35 of the U.S. Code, Capella asserts that the patents were recently issued by the United States Patent Office

> after a finding that they complied with all patent laws. They are presumed valid and that presumption applies to the issue of obviousness. The claimed inventions have enjoyed tremendous commercial success as demonstrated by the widespread adoption in the industry, including by Cisco, Ciena, Infinera and Fujitsu. The inventions supplied a long felt need for a compact, scalable, all-optical switching device with power control as set forth in the Background section of the patents. The industry including Fujitsu has since adopted and copied Capella's solution.

Id. at 9–10.

2033. As an initial matter, it is my understanding that the issuance of a patent by the Patent Office—no matter how recent—is not a secondary consideration of nonobvious.

2034. I understand that the secondary considerations for non-obviousness must relate to what is both claimed and novel in the alleged invention. I understand this is known as the "nexus" between the evidence and the claimed merits of the invention. I understand that no such nexus exists when the commercial success of an invention is due to an element in the prior art. I also understand that no nexus exists when commercial success is due to an element not actually claimed in the device, or an element not reasonably commensurate with the scope of the claims.

2035. With respect to Capella's allegation that "[t]he claimed inventions have enjoyed tremendous commercial success as demonstrated by the widespread adoption in the industry, including by Cisco, Ciena, Infinera and Fujitsu," I note that Capella has not provided any evidence of commercial success. It is my understanding that Capella has not demonstrated that Cisco, Ciena, Infinera, or Fujitsu adopted what Capella alleges are the "claimed inventions" and—even if Capella did so—there is no evidence that any such commercial success in any way relates to what is actually claimed and allegedly novel. Indeed, Capella has not alleged what alleged novelty in the Asserted Claims actually generated any commercial success. Regardless, it is my understanding that Capella produced and marketed several products that it claims practiced the Asserted Patents (*see* Capella's Infringement Contentions at 5), yet Capella failed

to generate any commercial success and was forced to sell its business (*see, e.g.*, Schwerin Tr. at 73:9–75:2, 91:7–10, 147:7–18, 164:22–165:2).

2036. With respect to Capella's allegation that it "supplied a long felt need for a compact, scalable, all-optical switching device with power control as set forth in the Background section of the patents[,]" I note that Capella has failed to explain how the Asserted Claims encompass a switching device that is more "compact" or "scalable" than that in the prior art. In fact, based on my review of the prior art discussed throughout this report, the Asserted Claims would provide an all-optical switching device with power control that is no more "compact" or "scalable" than those that already existed in the prior art. As to Capella's allegation with respect to an "all-optical switching device with power control," such devices already existed in the prior art, as discussed throughout this report and in Defendants' Invalidity Contentions. Prior art references covering all-optical switching devices included, for example, Tew '640 (*see* Tew '640 at 3:27–31), Solgaard (*see, e.g.*, Solgaard at 1:19–3:14), Lalonde (*see, e.g.*, Lalonde at 1:5–3:27), Lin (*see, e.g.*, Lin at Abstract and 1:28–3:60), Pan (*see, e.g.*, Pan at Abstract and 1:6–3:11), Tomlinson (*see, e.g.*, Abstract and 1:3–4:52), Trutna (*see, e.g.*, Trutna at Abstract and 1:5–5:22), Weverka (*see, e.g.*, Weverka at Abstract and 1:10–3:19), Kramer (*see, e.g.*, Kramer at Abstract and 1:15–2:62), and Dragone (*see, e.g.*, Dragone at Abstract and 1:5–67). Prior art references covering all-optical switching devices with power control included, for example, Smith (*see, e.g.*, Smith at 2:43–3:21), Carr (*see, e.g.*, Carr at 11:4–25), Hoen (*see, e.g.*, Hoen at 1:10–4:8 and 8:52–9:14), Sparks (*see, e.g.*, Sparks at Abstract and 1:4–3:47), Bouevitch (*see, e.g.*, Bouevitch at Abstract, 1:8–3:63), and Rose (*see, e.g.*, Rose at 1:13–3:27 and 11:37–41).

2037. With respect to Capella's allegation that the industry including Infinera and Fujitsu have since adopted and copied Capella's solution, I incorporate my analysis above for Capella's allegation of commercial success—there is no evidence that the industry adopted Capella's solution, or, even if there were any such adoption, that the said adoption relate to the Asserted Claims or any alleged point of novelty. Additionally, I have seen no evidence that the industry, let alone Infinera or FNC, copied Capella's alleged "solution."

4. Conclusion of Obviousness

2038. Based on my consideration and analysis of the *Graham* factors[14] discussed above, it is my opinion that each of the Asserted Claims as a whole would have been obvious to a POSITA before the time of invention.

X. LACK OF WRITTEN DESCRIPTION

2039. It is my opinion that claims 23–29, 31–35, 37, 39, and 44–54 of the '905 Patent and claims 68–72, 79–85, 87–92, 96–100, 106, 115–118, 122–127, 129–135, and 137–139 of the '906 Patent are invalid for lack of written description under pre-AIA 35 U.S.C. § 112, ¶ 1.

A. The Common Specification Lacks Written Description Support for a System That Uses Non-Movable, Non-Reflective Beam-Deflecting Elements

2040. It is my opinion that the subject matter allegedly claimed in claims 23–29, 31–35, 37, 39 and 44–54 of the '905 Patent and claims 133–135 and 137–139 of the '906 Patent is not sufficiently described in the specification to convey to those skilled in the art that the inventors had possession of the claimed subject matter as of Asserted Patents' filing date. Specifically, a POSITA reviewing the common specification and the Provisional Application would

[14] As explained above, the *Graham* factors are (1) the level of ordinary skill in the art; (2) the scope and content of the prior art; (3) the differences between the prior art and the claimed invention; and (4) any secondary indicia of obviousness.

understand that the inventors had possession of an alleged invention that used movable and reflective "channel micromirrors" and "beam-deflecting elements" to direct light. Because the above-identified claims are not limited to movable and reflective "beam-deflecting elements" (*see* Claim Construction Order at 33–34 (Feb. 9, 2021)), a POSITA would have understood that the named inventors had possession of the full scope of the claims.

2041. The Asserted Patents share a common specification. As described above, the specification describes an apparatus that "uses a diffraction grating to separate a multi-wavelength optical signal by wavelength into multiple spectral channels, which are then focused onto an array of corresponding channel micromirrors." '905 Patent, Abstract. The channel micromirrors "are individually controllable and continuously pivotable to reflect the spectral channels into selected output ports." *Id*. The channel micromirrors may be provided by "beam-deflecting elements." *Id*. at 9:22–25.

2042. A POSITA would recognize that every embodiment describes "beam-deflecting elements" as movable and reflective. There is no embodiment in which "beam-deflecting elements" are static or do not control the direction of light with reflection.

2043. As an initial matter, the specification explains that "channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of ***beam-deflecting elements*** known in the art." '905 Patent at 9:22–25 (emphasis added); '906 Patent at 9:36–39. The specification discloses only "silicon micromachined mirrors" and "reflective ribbons (or membranes)" as types of beam-deflecting elements, and the absence of other examples confirms that the only embodiments of beam-deflecting elements in the Asserted Patents are both movable and reflective.

2044. A POSITA would recognize that the Provisional Application describes "micromachined mirrors and deflectors." A POSITA reviewing the Provisional Application would recognize that (1) every embodiment describes the recited "micromachined mirrors and deflectors" as movable and reflective, and (2) the Provisional Application repeatedly and consistently describes "micromachined mirrors and deflectors" as movable and reflective. There is no embodiment in which the "micromachined mirrors and deflectors" are static or do not control the direction of light with reflection.

2045. With respect to the "micromachined mirrors" disclosed by the Provisional Application, the Provisional Application always describes the mirrors as movable and reflective. Under the "Description of the Invention" section, the Provisional Application describes the alleged invention as using "analog mirrors under servo control," Provisional Application No. 60/277,217 at 2, and the Provisional Application describes that servo control as controlling "dynamic mirror[s] capable of rotation about two orthogonal axes[]" (*id*. at 5). In fact, whenever the Provisional Application describes how the "micromachined mirrors" reflect light, the "micromachined mirrors" are described as movable. See Provisional Application No. 60/277,217 at 4 ("This requires the micromirrors to be dynamically adjustable with at least one axis of rotation."), *id*. ("By controlling the angle of each micromirror . . . ."), 5 ("Here a collimated beam reflects off a dynamic mirror capable of rotation about two orthogonal axes."), *id*. ("The sensitivity to change in the mirror angle depends on the focal length of the coupling lens. . . . The 2-axis dynamic mirror can take the form of a double-gimbaled torsional mirror. . . ."), *id*. (describing a "dynamic mirror array"), *id*. at 6 ("To facilitate feedback control of the dynamic mirrors . . . ."), *id*., Fig. 17 (showing a "2-axis mirror"), Fig. 21 (showing how the "coupling efficiency" changes according to the "micro mirror angle"). The Provisional

Application does not disclose any embodiment of the alleged invention in which the "micromachined mirrors and deflectors" are non-movable or do not control the direction of light with reflection.

2046. The Provisional Application similarly describes "deflectors" as being both movable and reflective, and gives a "reflective ribbon" as an example of a movable and reflective deflector:

> Each of the mirrors in the micromirror array reflects its associated wavelength channel back through the focusing lens, to the grating, and back towards one of the output ports. This requires the micromirrors to be dynamically adjustable with at least one axis of rotation. The rotational motion should be under analog control, so that the angles can be continuous [sic] adjusted to scan across all possible collimator ports. Various types of micromachined mirrors and deflectors exist in the art. One prior art implementation is shown here in Figure 12. This is ***an array of reflective ribbons, the position of each ribbon is under electrostatic control*** (made by Silicon Light Machines, Inc. Sunnyvale, CA). ***An adaptation of such a ribbon array can be used in the present invention to provide the micromirror function, with each ribbon in the array acting as a separately controllable mirror***.

Provisional Application No. 60/277,217 at 4 (emphasis added). Figure 12 shows that each of these reflective ribbons are physically movable based on the electrostatic control under each ribbon. *Id.*, Fig. 12 (describing "Silicon Light Machines MEMS Ribbon Deflector Array" and showing the reflective ribbons in "Up" and "Down" positions). And, the text reproduced above makes clear that a POSITA, when used in the invention, each "reflective ribbon" (and other types of deflectors) "in the array act[s] as a separately controllable *mirror*"—i.e., they are movable and reflective.

2047. Thus, the specification and the Provisional Application provide a consistent description of "beam-deflecting elements" as both movable and reflective because every

embodiment (e.g., silicon micromachined mirrors and reflective ribbons or membranes) has these features.

2048. In addition, every embodiment referencing "channel micromirrors" describes them as being reflective and movable/rotatable/pivotable about one or two axes:

> This invention provides a novel wavelength-separating-routing (WSR) apparatus that uses a diffraction grating to separate a multi-wavelength optical signal by wavelength into multiple spectral channels, which are then focused onto an array of corresponding channel micromirrors. ***The channel micromirrors are individually controllable and continuously pivotable*** to reflect the spectral channels into selected output ports.

Id., Abstract (emphasis added).

> In the WSR apparatus of the present invention . . . ***each channel micromirror may be pivotable*** about one or two axes."

Id. at 4:27–37 (emphasis added).

> The channel micromirrors 103 are individually controllable and ***movable, e.g., pivotable (or rotatable) under analog (or continuous) control***, such that, upon reflection, the spectral channels are directed into selected ones of the output ports 110-2 through 110-N by way of the focusing lens 102 and the diffraction grating 101. As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror".

Id. at 7:20–27 (emphasis added).

> Depicted in FIG. 1B is a close-up view of the channel micromirrors 103 shown in the embodiment of FIG. 1A. By way of example, the channel micromirrors 103 are arranged in a one-dimensional array along the x-axis (i.e., the horizontal direction in the figure), so as to receive the focused spots of the spatially separated spectral channels in a one-to-one correspondence. (As in the case of FIG. 1A, only three spectral channels are illustrated, each represented by a converging beam.) ***Let the reflective surface of each channel micromirror lie in the x-y plane as defined in the figure and be movable, e.g., pivotable (or deflectable) about the x-axis in an analog (or continuous) manner***. Each spectral channel, upon reflection, is deflected in the y-direction (e.g., downward) relative to its incident direction, so to be directed into one of the output ports 110-2 through 110-N shown in FIG. 1A.

> As described above, a unique feature of the present invention is that the motion of ***each channel micromirror is individually and continuously controllable, such that its position, e.g., pivoting angle, can be continuously adjusted***. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port. To illustrate this capability, FIG. 1C shows a plot of coupling efficiency as a function of a channel micromirror's pivoting angle Θ, provided by a ray-tracing model of a WSR apparatus in the embodiment of FIG. 1A.

Id. at 8:22–45 (emphasis added).

> The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting elements known in the art. And ***each micromirror may be pivoted about one or two axes. What is important is that the pivoting (or rotational) motion of each channel micromirror be individually controllable in an analog manner***, whereby the pivoting angle can be continuously adjusted so as to enable the channel micromirror to scan a spectral channel across all possible output ports.

Id. at 9:22–31 (emphasis added).

> FIG. 3 shows a fourth embodiment of a WSR apparatus according to the present invention. By way of example, WSR apparatus 300 is built upon and hence shares a number of the elements used in the embodiment of FIG. 2B, as identified by those labeled with identical numerals. In this case, the one-dimensional fiber collimator array 110 of FIG. 2B is replaced by a two-dimensional array 350 of fiber collimators, providing for an input-port and a plurality of output ports. Accordingly, the one-dimensional collimator-alignment mirror array 220 of FIG. 2B is replaced by a two-dimensional array 320 of collimator-alignment mirrors, and first and second one-dimensional arrays 260, 270 of imaging lenses of FIG. 2B are likewise replaced by first and second two-dimensional arrays 360, 370 of imagining lenses respectively. As in the case of the embodiment of FIG. 2B, the first and second two-dimensional arrays 360, 370 of imaging lenses are placed in a 4-f telecentric arrangement with respect to the two-dimensional collimator-alignment mirror array 320 and the two-dimensional fiber collimator array 350. ***The channel micromirrors 103 must be pivotable biaxially in this case (in order to direct its corresponding spectral channel to any one of the output ports)***. As such, the WSR apparatus 300 is equipped to support a greater number of the output ports.

Id. at 10:44–67 (emphasis added). Accordingly, the entirety of the specification demonstrates that the alleged invention required that each of the "channel micromirrors" be reflective and movable/pivotable/rotatable.

2049. A POSITA would recognize that others skilled in the art reading the Asserted Patents believed that the specification of the Asserted Patents only describes the use of reflective and movable elements for switching a spectral channel, such as MEMS-based devices. First, U.S. Patent Application No. 13/532,735 (which published as U.S. Patent Publication No. 20120328291A1 and issued as U.S. Patent No. 8,867,917) describes the Capella patent publication as disclosing "MEMS based WSS devices." A POSITA would recognize that a MEMs-based WSS device uses movable, reflective mirrors to deflect light. That is consistent with the intrinsic evidence, which informs a POSITA that a "beam-deflecting element" is a movable and reflective element. Second, U.S. Patent Application No. 13/532,735 itself notes that the Capella patent publication "includes a 2-dimensional array of individually ***tiltable mirrors***[,]" indicating movable and reflective elements. Third, a POSITA would recognize that the "MEMS based WSS devices" disclosed by the Capella patent publication are juxtaposed with the Liquid Crystal on Silicon ("LCoS") devices disclosed by U.S. Patent No. 7,092,599 to Frisken. A POSITA would recognize that LCoS devices operate on a different principle: rather than relying on movable and reflective element to direct light, LCoS — which "provide[s] a local phase change to an optical signal" — does not rely on movement and changes a refractive element rather than a reflective element to modify the direction of light. In other words, U.S. Patent Application No. 13/532,735 recognizes that the specification of the Asserted Patents is limited to the use of reflective and movable elements for switching or directing a spectral channel to a selected output port.

2050. It is my opinion that the Asserted Patents' specification would not convey to a person of ordinary skill in the art that the inventors had possession of any device or method that used a non-reflective, non-movable element for switching or directing a spectral channel to a selected output port at the time the Asserted Patents were filed.

2051. I understand that Capella asserts the claims of the Asserted Patents that require "beam-deflecting elements" against devices that do not use a reflective and movable element for directing a spectral channel to a selected output port, and alleges that the claims of these patents cover devices that do not use a reflective and movable element for directing a spectral channel to a selected output port. Specifically, Capella asserts that "LCoS-based switching modules" satisfy the "beam-deflecting element" term and describes these "LCoS-based switching modules" as follows:

> The LCoS-based switching modules use a matrix of phase controlled pixels to create a spatial array of channel micromirrors. ***The width of each channel micromirror is controlled by varying the number of pixel columns selected in a first (e.g., horizontal) direction. Channel reflection into a selected fiber collimator output port is controlled by pivoting fibers within the pixels in a second direction (e.g., in a vertical column) and creating optical phase retardation in the direction of the intended deflection.*** The switching module controls beam deflection and optical power by varying the pitch and blaze of the pixels in the columns thereby creating grating patterns. The LCoS array is able to dynamically and continuously control beam reflection and power, dispersion, phase and amplitude. The LCoS is also able to perform additional filter functions.

E.g., Infringement Contentions Against Infinera at 102 (emphasis added) (native PDF pagination). Based on Capella's own description, the "LCoS-based switching modules" themselves are not capable of "motion, e.g., pivoting (or rotation)." In addition, the LC cells within an LCoS module are not reflective.

2052. There is no disclosure or mention in the Asserted Patents of an "LCoS-based switching module" or even an LCoS array. The specifications of the Asserted Patents do not even include the words Liquid Crystal on Silicon (LCoS) or liquid crystal. LCoS technology is not described or disclosed in the Asserted Patents. The specification demonstrates that the named inventors were not in possession of an apparatus, system, or method that used "LCoS-based switching modules."

2053. Capella's expert Dr. Alexander Sergienko agreed that a publication purporting to cover an LCoS device would need to describe that the device is based on LCoS technology:

> Q. And what would the publication have to say about that element that is doing the switching to inform a person of ordinary skill that the publication is discussing LCOS?
>
> MR. KERTELL: Objection. Form.
>
> THE WITNESS: It will describe that the switching elements, the deflecting light elements is based on liquid crystal on silicon technology.

Sergienko Tr. at 48:19–49:2. Named inventor of the Asserted Patents, Jeffrey Wilde, had the same view as Capella's expert:

> Q. So if I wanted to figure out if a publication discussing spatial light modulators was talking about an LCoS spatial light modulator, what would I look for?
>
> MR. BECKER: Object. Form.
>
> THE WITNESS: Electrically controllable would be one aspect.
>
> BY MR. GAUSTAD: Anything else?
>
> MR. BECKER: Object. Form.
>
> THE WITNESS: That would be the primary distinction. And usually if it's using liquid crystal, you're marrying properties of a liquid crystal, so that would probably be mentioned in any technical discussion.

Wilde Tr. at 90:18–91:7.

2054. It is my opinion that the specification of the Asserted Patents does not describe non-movable, non-reflective "beam-deflecting elements" that could conceivably be covered by claims 23–29, 31–35, 37, 39 and 44–54 of the '905 Patent and claims 133–135 and 137–139 of the '906 Patent. Under the Court's claim construction that does not require the recited "beam-deflecting elements" to be movable and reflective, it is my opinion that the specification would not convey to a POSITA that the inventors possessed the alleged full scope of the subject matter claimed in the asserted claims of the Asserted Patents.

2055. Based on the disclosures of the Asserted Patents, a POSITA would not understand that the inventors had invented a wavelength separating and routing apparatus or an optical add-drop multiplexer that uses an LCoS-based switching module or LCoS technology. The LCoS-based switching modules are not both moveable and reflective.

B. The Specification Lacks Written Description Support for a System that Does Not Continuously Control Channel Micromirrors or Beam-Deflecting Elements

2056. It is my opinion that the subject matter allegedly claimed in claims 89–92 and 96–99 of the '906 Patent is not sufficiently described in the specification to convey to those skilled in the art that the inventors had possession of the claimed subject matter as of Asserted Patents' filing date.

2057. A POSITA would recognize that every embodiment of the Asserted Patents describes "channel micromirrors" and "beam-deflecting elements" as continuously controllable. There is no embodiment in which "channel micromirrors" or "beam-deflecting elements" are not continuously controllable. Below are some supporting passages from the specification:

> ***A distinct feature of the channel micromirrors in the present invention***, in contrast to those used in the prior art, ***is that the motion***, e.g., pivoting (or rotation), of each channel micromirror ***is under analog control such that its pivoting angle can be continuously adjusted***. This enables each channel micromirror to

> scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port.

’905 Patent at 4:19–26 (emphasis added).

> ***By advantageously employing an array of channel micromirrors that are individually and continuously controllable***, an OADM of the present invention is capable of routing the spectral channels on a channel-by-channel basis and directing any spectral channel into any one of the output ports.

Id. at 5:64–6:2 (emphasis added).

> ***The channel micromirrors 103 are*** individually controllable and movable, e.g., pivotable (or rotatable) ***under analog (or continuous) control***, such that, upon reflection, the spectral channels are directed into selected ones of the output ports 110-2 through 110-N by way of the focusing lens 102 and the diffraction grating 101.

Id. at 7:20–25 (emphasis added).

> As described above, ***a unique feature of the present invention is that the motion of each channel micromirror is individually and continuously controllable***, such that its position, e.g., pivoting angle, can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port.

Id. at 8:38–45 (emphasis added).

> ***What is important is that*** the pivoting (or rotational) motion of ***each channel micromirror*** be individually controllable in an analog manner, whereby the pivoting angle ***can be continuously adjusted*** so as to enable the channel micromirror to scan a spectral channel across all possible output ports.

Id. at 9:26–31 (emphasis added).

2058. Similarly, every embodiment disclosed in the Provisional Application requires continuous control. For example:

> Each of the mirrors in the micromirror array reflects its associated wavelength channel back through the focusing lens, to the grating,

> and back towards one of output ports. This requires the micromirrors to be dynamically adjustable with at least one axis of rotation. ***The rotational motion should be under analog control, so that the angles can be <u>continuous adjusted</u> to scan across all possible output collimator ports***. Various types of micromachined mirrors and deflectors exist in the art. One prior art implementation is shown here in Figure 12. This is an array of reflective ribbons, the position of each ribbon being under electrostatic control (made by Silicon Light Machines, Inc., Sunnyvale, CA). An adaptation of such a ribbon array can be used in the present invention to provide the micromirror function, with each ribbon in the array acting as a separately controllable mirror.

Provisional Application at 4 (emphasis added).

2059. Claims 89–92 and 96–99 of the '906 Patent do not explicitly require "continuously controllable" "channel micromirrors" or "beam-deflecting elements." Assuming that "continuously controllable" is not inherently required by these claims, it is my opinion that a POSITA reviewing the specification would not understand that the named inventors were in possession of the full scope of the alleged invention. There is no disclosure or mention in the Asserted Patents of "channel micromirrors" or "beam-deflecting elements" that are not "continuously controllable," and every embodiment requires continuous control.

2060. Based on the disclosures of the Asserted Patents, a POSITA would not understand that the inventors had invented a wavelength separating and routing apparatus or an optical add-drop multiplexer in which "channel micromirrors" or "beam-deflecting elements" are not continuously controllable.

C. The Specification Lacks Written Description Support for a System that Does Not Individually Control Channel Micromirrors or Beam-Deflecting Elements

2061. It is my opinion that the subject matter allegedly claimed in claims 51–54 of the '905 Patent and claims 133–35 and 137–39 of the '906 Patent is not sufficiently described in the

specification to convey to those skilled in the art that the inventors had possession of the claimed subject matter as of Asserted Patents' filing date.

2062. A POSITA would recognize that every embodiment of the Asserted Patents describes "channel micromirrors" and "beam-deflecting elements" as individually controllable. There is no embodiment in which "channel micromirrors" or "beam-deflecting elements" are not individually controllable. Below are some supporting passages from the specification:

> ***The channel micromirrors are individually controllable*** and continuously pivotable to reflect the spectral channels into selected output ports.

'905 Patent at Abstract (emphasis added).

> ***The channel micromirrors are individually controllable*** and movable, e.g., continuously pivotable (or rotatable), so as to reflect the spectral channels into selected ones of the output ports.

Id. at 4:11–14 (emphasis added).

> ***By advantageously employing an array of channel micromirrors that are individually and continuously controllable***, an OADM of the present invention is capable of routing the spectral channels on a channel-by-channel basis and directing any spectral channel into any one of the output ports.

Id. at 5:64–6:2 (emphasis added).

> ***The channel micromirrors 103 are individually controllable*** and movable, e.g., pivotable (or rotatable) under analog (or continuous) control, such that, upon reflection, the spectral channels are directed into selected ones of the output ports 110-2 through 110-N by way of the focusing lens 102 and the diffraction grating 101.

Id. at 7:20–25 (emphasis added).

> As described above, ***a unique feature of the present invention is that the motion of each channel micromirror is individually and continuously controllable***, such that its position, e.g., pivoting angle, can be continuously adjusted. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port.

Id. at 8:38–45 (emphasis added).

> ***What is important is that*** the pivoting (or rotational) motion of ***each channel micromirror be individually controllable*** in an analog manner, whereby the pivoting angle can be continuously adjusted so as to enable the channel micromirror to scan a spectral channel across all possible output ports.

Id. at 9:26–31 (emphasis added).

2063. Similarly, every embodiment disclosed in the Provisional Application requires individual control. For example:

> ***<u>Each of the mirrors in the micromirror array reflects its associated wavelength channel</u> back through the focusing lens, to the grating, and back towards one of output ports. This requires the micromirrors to be dynamically adjustable with at least one axis of rotation. The rotational motion should be under analog control, so that <u>the angles can be</u> continuous <u>adjusted</u> to scan across all possible output collimator ports***. Various types of micromachined mirrors and deflectors exist in the art. One prior art implementation is shown here in Figure 12. This is an array of reflective ribbons, the position of each ribbon being under electrostatic control (made by Silicon Light Machines, Inc., Sunnyvale, CA). ***An adaptation of such a ribbon array can be used in the present invention to provide the micromirror function, with <u>each ribbon</u> in the array acting as a <u>separately controllable</u> mirror.***
>
> . . .
>
> ***By <u>controlling independently the angle of each micromirror</u>, the system has the ability to direct each wavelength channel to any of the outputs (pass-through or drop)***. The presence of multiple drops ports allows for the possibility of putting only one wavelength on one drop port, thereby avoiding the additional demultiplexing (and the associated cost and complexity) that would otherwise be required with the prior art device of Figures 5 and 6. Feedback control of the mirror positions makes the system stable. More detail regarding the control system is provided in the following sections. This system can readily scale to large channel count by simply adding more mirrors to the mirror array.

Provisional Application at 4 (emphasis added).

2064. Claims 51–54 of the ’905 Patent and claims 133–35 and 137–39 of the ’906 Patent do not explicitly require “individually controllable” “channel micromirrors” or “beam-deflecting elements.” Assuming that “individually controllable” is not inherently required by these claims, it is my opinion that a POSITA reviewing the specification would not understand that the named inventors were in possession of the full scope of the alleged invention. There is no disclosure or mention in the Asserted Patents of “channel micromirrors” or “beam-deflecting elements” that are not “individually controllable,” and every embodiment requires individual control.

2065. Based on the disclosures of the Asserted Patents, a POSITA would not understand that the inventors had invented a wavelength separating and routing apparatus or an optical add-drop multiplexer in which “channel micromirrors” or “beam-deflecting elements” are not individually controllable.

XI. CONCLUSION

2066. For the reasons explained above, I conclude that each of the Asserted Claims are invalid for multiple independent reasons. My opinions on other relevant issues are also set forth herein.

2067. I reserve the right to amend and/or supplement the foregoing in accordance with applicable Court rules, orders and procedures, and in response to newly disclosed positions on invalidity issues by Capella.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct.

Executed on March 15, 2021

By: ______________________________
Michael S. Lebby

EXHIBIT 2

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

CAPELLA PHOTONICS, INC.	§	
	§	
v.	§	CASE NO. 2:20-CV-0077-JRG
	§	
INFINERA CORPORATION, ET AL.	§	

INFINERA'S INITIAL INVALIDITY CONTENTIONS

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I. INTRODUCTION

Pursuant to the Local Patent Rules and the Court's Docket Control Order in the above-captioned case (Dkt. 33 at 4)[1], Defendants Infinera Corporation, Tellabs, Inc., Tellabs Operations Inc., Coriant America Inc., and Coriant (USA) Inc. (collectively, "Infinera" or "Defendants") serve these Invalidity Contentions on Plaintiff Capella Photonics, Inc. ("Capella" or "Plaintiff") for United States Patent Nos. RE47,905 (the "905 Patent") and RE47,906 (the "'906 Patent") (collectively, the "Asserted Patents"). These Invalidity Contentions are based on Infinera's current knowledge of the Asserted Patents and prior art, along with its understanding of Capella's infringement allegations set forth in Capella's May 25, 2020 Disclosure of Asserted Claims and Infringement Contentions ("Infringement Contentions"). Based on Capella's Infringement Contentions, Capella is asserting the following claims against Infinera (collectively, the "Asserted Claims"):

Patent	**Asserted Claim(s)**
The '905 Patent	23–29, 31–35, 37, 39, and 44–54
The '906 Patent	68–72, 79–85, 87–92, 96–100, 106, 115–118, 122–127, 129–135, and 137–139

Infinera submits these Contentions without waiving any arguments about the sufficiency or substance of Capella's Infringement Contentions, and without waiving any challenges to Capella's apparent claim constructions.[2] Based in whole or in part on the claim interpretations

[1] Unless indicated otherwise, docket citations throughout these Invalidity Contentions refer to Civil Action No. 2:20-cv-00077-JRG (E.D. Tex.).

[2] In a July 15, 2020 letter, Infinera challenged the sufficiency of Capella's infringement contentions on a number of grounds and subsequently met and conferred with Capella to discuss the deficiencies of the infringement contentions.

that Capella appears to be asserting, and its alleged application of those interpretations to the accused instrumentalities, Infinera contends that each cited prior art reference listed below anticipates or renders obvious the Asserted Claims, as described below and in the associated claim charts, attached hereto and incorporated by reference as if fully set forth herein.

Identifying these items of prior art and other defenses in connection with these Contentions does not serve as an admission, or waiver of any argument or position refuting, that any alleged "Accused Instrumentality," including any current or past version of any alleged "Accused Instrumentality," is covered by, or infringes any of the Asserted Claims (or any other claims of the Patents-in-Suit), particularly when the Asserted Claims are properly construed. Further, Infinera's Contentions should not be construed as an admission regarding the proper construction of any asserted claim, should not be deemed to represent or limit the claim constructions that Infinera will advance in this action, and should not be deemed to relate to the non-infringement positions Infinera may advance in this action.

Infinera's Contentions reflect Infinera's current knowledge and contentions as of this early date in this action. Infinera's Contentions are based in whole or in part on its present understanding of the Asserted Claims and Capella's apparent position as to the scope of the Asserted Claims as applied in its Local Patent Rule 3-1 disclosure. Accordingly, Infinera's Contentions (including the attached invalidity claim charts) reflect, to the extent possible, Capella's expected alternative and potentially inconsistent positions as to claim construction and claim scope.

As Infinera noted in its Answer (Dkt. 22), in 2016, the Patent Trial and Appeal Board ("PTAB") issued several Final Written Decisions based on Petitions for *Inter Partes* Review ("IPRs") that were filed challenging certain claims of U.S. Patents Nos. RE42,368 and

RE42,678, which were predecessors to the Asserted Patents. The PTAB found that a number of claims in the predecessor '368 and '678 Patents were invalid pursuant to 35 U.S.C. § 103 based on various prior art references and cancelled those claims. On February 12, 2018, the Federal Circuit summarily affirmed these decisions in *Capella Photonics, Inc. v. Cisco Systems, Inc., Ciena Corp., Coriant Operations, Inc., Coriant (USA) Inc., Fujitsu Network Communications, Inc., Lumentum Holdings, Inc., Lumentum Inc., Lumentum Operations, LLC*, Nos. 2016-2394, 2016-2395, 2017-1105, 2017-1106, 2017-1107, 2017-1108. On April 16, 2018, the Federal Circuit issued its mandate. On November 5, 2018, the United States Supreme Court denied a Petition for Writ of Certiorari filed by Capella. Accordingly, the PTAB's Final Written Decisions and the Federal Circuit's affirmance of those decisions are final and non-appealable. Accordingly, Capella is collaterally estopped from challenging the invalidity of Asserted Claims in the '905 and '906 Patent that are substantially similar to claims of the predecessor '368 and '678 Patents that were cancelled by the PTAB. *See, e.g.*, *Ohio Willow Wood Co. v. Alps South, LLC*, 735 F.3d 1333, 1342 (Fed. Cir. 2013); *Soverain Software LLC v. Victoria's Secret Direct Brand Mgmt, LLC*, 778 F.3d 1311, 1319 (Fed. Cir. 2015). Capella is also collaterally estopped from challenging determinations necessary to support the PTAB's judgments in the IPRs, including, for example and without limitation, determinations by the PTAB that (1) certain materials are prior art, (2) disclosures from certain materials teach certain claim limitations, and/or (3) a person of ordinary skill in the art would have been motivated to combine certain teachings. Infinera incorporates into these Contentions the materials from the PTAB proceedings, the Federal Circuit proceedings, and the Supreme Court proceedings, including but not limited to the petitions for *inter partes* review and the accompanying exhibits, the PTAB's Final Written Decisions, and the Federal Circuit's summary affirmance. This incorporation by

reference includes, but is not limited to, identifications and descriptions of prior art, combinations of prior art, and motivations to combine prior art.

Additionally, various defendants served invalidity contentions against the predecessor ’368 and ’678 Patents. *See, e.g.*, *Capella Photonics, Inc. v. Tellabs, Inc.*, No. 3:14-cv-03350-EMC (S.D. Fla.) (Dkt. 62, filed June 16, 2014). Infinera incorporates these previously-served invalidity contentions into the current Contentions by reference, including but not limited to identifications and descriptions of prior art, combinations of prior art, and motivations to combine prior art.

Infinera reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to modify and supplement, without prejudice, these Contentions. In addition, Infinera reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to raise additional prior art and invalidity defenses not included in these Contentions, including those based on additional discovery or other issues raised by Capella in this action or any related action. Infinera further reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to amend these Contentions should, for example, Capella provide any information that it failed to provide in its Initial Disclosures and/or its Infringement Contentions.

Further, because discovery has only recently begun, Infinera reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to revise, amend, and/or supplement the information provided herein, including identifying and relying on additional prior art references should Infinera’s further search and analysis yield additional information or references, consistent with the Local Patent Rules and the Federal Rules of Civil Procedure. Infinera expressly reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to rely on witness testimony about the prior art references identified below to

supplement these Contentions, where appropriate. Moreover, Infinera reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to revise its ultimate Contentions concerning the invalidity of the asserted claims, which may change depending upon the Court's construction of the Asserted Claims, any findings as to the priority date of the Asserted Claims, and/or positions that Capella or its fact or expert witness(es) may take concerning claim construction, infringement, and/or invalidity issues.

The accompanying invalidity claim charts list specific examples of where prior art references disclose, either expressly or inherently, each limitation of the Asserted Claims and/or examples of disclosures in view of which a person of ordinary skill in the art at the time each of the alleged inventions was made, would have considered each limitation, and therefore the claim as a whole, obvious. The references, however, may contain additional support upon which Infinera may rely that is not specifically identified in these contentions. The citations included in each chart are illustrative, not exhaustive. For any given quotation or excerpt, for example, Infinera expressly reserves the right to introduce other text and images (including but not limited to surrounding, related, or explanatory text, images, or un-cited portions of the prior art references) from the same or other prior art references that may help to provide context to the quotation or excerpt. Furthermore, where Infinera cites to a particular figure in a reference, the citation should be understood to encompass the caption and description of the figure and any text relating, in any manner, to the figure. Similarly, where Infinera cites to particular text referring to a figure, the citation should be understood to include the corresponding figure as well. Infinera may also rely on other documents and information, including cited references and prosecution histories for the Asserted Patents or related patents (including but not limited to patents and/or patent applications, within the same family or at any time assigned to Capella),

and witness testimony, including expert testimony, to explain, amplify, illustrate, demonstrate, provide context or aid in understanding the cited portions of the references.

II. P.R. 3-3(a): IDENTIFICATION OF PRIOR ART

Pursuant to Local Patent Rule 3-3(a), and subject to Infinera's reservation of rights, Infinera contends that one or more Asserted Claims of the Asserted Patents are anticipated or rendered obvious by the prior art identified below and as reflected in the attached Appendices (A-1–A-21 and B-1–B-21. Infinera also contends that the Accused Instrumentalities do not infringe any Asserted Claim of any Asserted Patent.

Infinera reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to assert that the Asserted Claims are invalid under pre-AIA 35 U.S.C. § 102(f) in the event Infinera obtains additional evidence that the named inventors of the Asserted Patents did not invent (either alone or in conjunction with others) the subject matter claimed in the Asserted Patents. Should Infinera obtain such evidence, it will provide the name of the person(s) from whom, and the circumstances under which, the invention or any part of it was derived.

Infinera further intends to rely on admissions of the named inventors and Capella concerning the prior art, including statements found in the Asserted Patents, their prosecution history, and/or other related patents or patent applications, any deposition testimony, and the papers filed and any evidence submitted by Capella in conjunction with this action.

Finally, Infinera may rely on testimony from the authors or named inventors listed on the below references.

The following patents and patent publications are prior art to the Asserted Patents under at least pre-AIA 35 U.S.C. §§ 102(a), (b), (e), and/or (g).

<u>Table A-1</u>

Chart(s)	Country/Patent Number	Publication/Issue Date
A/B-1	U.S. Patent No. 6,816,640 ("*Tew '640*")[3]	Nov. 9, 2004 (issued)
A/B-2	U.S. Patent No. 6,618,520 ("*Tew '520*")[4]	Sept. 9, 2003 (issued)
A/B-3	U.S. Patent Application Publ'n No. 2002/0081070 ("*Tew '070*")[5]	June 27, 2002 (published)
A/B-4	U.S. Patent No. 6,798,941 ("*Smith*")[6]	Sept. 28, 2004 (issued)
A/B-5	U.S. Patent No. 6,442,307 ("*Carr*")[7]	Aug. 27, 2002 (issued)
A/B-6	U.S. Patent No. 6,097,859 ("*Solgaard*")[8]	Aug. 1, 2000 (issued)

[3] The application for *Tew '640* was filed on September 28, 2001 and claims priority to Provisional Applications Nos. 60,164,532 (filed on September 29, 2000), 60/236,533 (filed on September 29, 2000), and 60/236,677 (filed on September 29, 2000). Accordingly, based on one or more of these provisional applications, *Tew '640* is entitled to a priority date of no later than September 29, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

Tew '640 was also published as U.S. Patent Publ'n No. 2002/0044722 on April 18, 2002.

[4] The application for *Tew '520* was filed on September 28, 2001 and claims priority to Provisional Applications Nos. 60/164,223 (filed November 9, 1999) and 60/236,533 (filed September 29, 2000). Accordingly, based on one or more of these provisional applications, *Tew '520* is entitled to a priority date of no later than November 9, 1999 or September 29, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

Tew '520 was also published as U.S. Patent Publ'n No. 2002/0034356 on March 21, 2002.

[5] The application for *Tew '070* was filed on November 13, 2001 and claims priority to U.S. Provisional Application No. 60/250,520 (filed November 30, 2000). Accordingly, based on this provisional application, *Tew '070* is entitled to a priority date of no later than November 30, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[6] The application for *Smith* was filed on September 20, 2001 and claims priority to U.S. Provisional Applications Nos. 60/234,683 (filed September 22, 2000) and 60/267,285 (filed February 7, 2001). Accordingly, based on these provisional applications, *Smith* is entitled to a priority date of no later than September 22, 2000 or February 7, 2001 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

Smith was also published as U.S. Patent Publ'n No. 2002/0071627 on June 13, 2002.

[7] The application for *Carr* was filed on November 3, 2000. Accordingly, *Carr* is entitled to a priority date of no later than November 3, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[8] The application for *Solgaard* was filed on February 12, 1998 and claims priority to U.S. Provisional Application No. 60/038,172 (filed February 13, 1997). Accordingly, based on the

Table A-1		
Chart(s)	**Country/Patent Number**	**Publication/Issue Date**
A/B-7	U.S. Patent No. 6,011,884 ("*Dueck*")[9]	Jan. 4, 2000 (issued)
A/B-8	U.S. Patent No. 7,106,966 ("*Lalonde*")[10]	Sept. 12, 2006 (issued)
A/B-9	U.S. Patent No. 6,253,001 ("*Hoen*")[11]	June 26, 2001 (issued)
A/B-10	U.S. Patent No. 6,625,340 ("*Sparks*")[12]	Sept. 23, 2003 (issued)
A/B-11	U.S. Patent No. 6,498,872 ("*Bouevitch*")[13]	Dec. 24, 2002 (issued)
A/B-12	U.S. Patent No. 6,978,062 ("*Rose*")[14]	Dec. 20, 2005 (issued)

utility application and the provisional applications, *Solgarrd* is entitled to a priority date of no later than February 13, 1997 or February 12, 1998 and is prior art under at least pre-AIA 35 U.S.C. § 102(e). Additionally, because *Solgaard* issued on August 1, 2000, *Solgaard* is also prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b), and (e).

[9] The application for *Dueck* was filed on December 13, 1997. Accordingly, *Dueck* is entitled to a priority date of no later than December 13, 1997 and is prior art under at least pre-AIA 35 U.S.C. § 102(e). Additionally, because *Dueck* issued on January 4, 2000, *Dueck* is also prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b), and (e).

[10] The application for *Lalonde* was filed on June 1, 2000. Accordingly, *Lalonde* is entitled to a priority date of no later than June 1, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[11] The application for *Hoen* was filed on January 20, 2000. Accordingly, *Hoen* is entitled to a priority date of no later than January 20, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b), and (e).

[12] The application for *Sparks* was filed on December 29, 1999. Accordingly, *Sparks* is entitled to a priority date of no later than December 29, 1999 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[13] The application for *Bouevitch* was filed on December 5, 2000 and claims priority to U.S. Provisional Application No. 60/183,155 (filed February 17, 2000). Accordingly, based on the utility application and the provisional applications, *Bouevitch* is entitled to a priority date of no later than February 17, 2000 or December 5, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[14] The application for *Rose* was filed on February 21, 2001. Accordingly, *Rose* is entitled to a priority date of no later than February 21, 2001 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

Table A-1		
Chart(s)	**Country/Patent Number**	**Publication/Issue Date**
A/B-13	U.S. Patent No. 5,661,591 ("*Lin*")[15]	Aug. 26, 1997 (issued)
A/B-14	U.S. Patent No. 5,689,593 ("*Pan*")[16]	Nov. 18, 1997 (issued)
A/B-15	U.S. Patent No. 5,960,133 ("*Tomlinson*")[17]	Sep. 28, 1999 (issued)
A/B-16	U.S. Patent No. 6,658,212 ("*Trutna*")[18]	Dec. 2, 2003 (issued)
A/B-17	U.S. Pat. No. 6,501,877 ("*Weverka*")[19]	Dec. 31, 2002 (issued)
A/B-18	U.S. Patent No. 6,496,291 ("*Raj*")[20]	Dec. 17, 2002 (issued)

Rose was also published as U.S. Patent Application Publ'n No. 2002/0154855 on October 24, 2002.

[15] The application for *Lin* was filed on September 29, 1995. Accordingly, *Lin* is entitled to a priority date of no later than September 29, 1995 and is prior art under at least pre-AIA 35 U.S.C. § 102(e). Additionally, because *Lin* issued on August 26, 1997, *Lin* is also prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b), and (e).

[16] The application for *Pan* was filed on September 6, 1996, and is a continuation-in-part of U.S. Patent Application No. 08/542,571 (filed October 13, 1995). Accordingly, based on the utility application and the parent application, *Pan* is entitled to a priority date of no later than October 13, 1995 or September 6, 1996 and is prior art under at least pre-AIA 35 U.S.C. § 102(e). Additionally, because *Pan* issued on November 18, 1997, *Pan* is also prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b), and (e).

[17] The application for *Tomlinson* was filed on January 27, 1998. Accordingly, *Tomlinson* is entitled to a priority date of no later than January 27, 1998 and is prior art under at least pre-AIA 35 U.S.C. § 102(e). Additionally, because *Tomlinson* issued on September 28, 1999, *Tomlinson* is also prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b), and (e).

[18] The application for *Trutna* was filed on October 31, 2000. Accordingly, *Trutna* is entitled to a priority date of no later than October 31, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[19] The application for *Weverka* was filed on November 16, 1999. Accordingly, *Weverka* is entitled to a priority date of no later than November 16, 1999 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[20] The application for *Raj* was filed on October 17, 2000. Accordingly, *Raj* is entitled to a priority date of no later than October 17, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

Table A-1		
Chart(s)	**Country/Patent Number**	**Publication/Issue Date**
A/B-19	U.S. Patent No. 6,583,934 ("*Kramer*")[21]	June 24, 2003 (issued)
A/B-20	U.S. Patent No. 6,263,127 ("*Dragone*")[22]	July 17, 2001 (issued)

The following non-patent publications are prior art to the Asserted Patents under at least pre-AIA 35 U.S.C. §§ 102(a), (b), and/or (g).

Table A-2			
Chart(s)	**Title**	**Publication Date**	**Author(s) / Publisher**
A/B-21	"General Formula for Coupling-loss Characterization of Single-mode Fiber Collimators by Use of Gradient-index Rod Lenses" ("*Yuan*")[23]	May 20, 1999	Shifu Yuan, Nabeel A. Riza / Applied Optics

Moreover, the following references illustrate the state of the art as of March 19, 2001 (what Capella claims is the priority date for the Asserted Claims), along with any references cited or otherwise referred to in these references or any applications (including provisional applications) to which these references claim priority:

- U.S. Patent No. 4,367,040
- U.S. Patent No. 4,707,056

[21] The application for *Kramer* was filed on February 9, 2001 and is a continuation-in-part of U.S. Patent Application No. 09/761,509 (filed January 16, 2001). Accordingly, based on the utility application and the parent application, *Kramer* is entitled to a priority date of no later than February 9, 2001 or January 16, 2001 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[22] The application for *Dragone* was filed on May 13, 1999. Accordingly, *Dragone* is entitled to a priority date of no later than May 13, 1999 and is prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b), and (e).

[23] *Yuan* was published May 20, 1999. Accordingly, *Yuan* is entitled to a priority date of no later than May 20, 1999 and is prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b).

- U.S. Patent No. 4,839,884
- U.S. Patent No. 4,844,617
- U.S. Patent No. 5,048,912
- U.S. Patent No. 5,076,692
- U.S. Patent No. 5,233,405
- U.S. Patent No. 5,276,498
- U.S. Patent No. 5,311,606
- U.S. Patent No. 5,315,431
- U.S. Patent No. 5,345,521
- U.S. Patent No. 5,414,540
- U.S. Patent No. 5,450,512
- U.S. Patent No. 5,477,350
- U.S. Patent No. 5,526,155
- U.S. Patent No. 5,600,851
- U.S. Patent No. 5,629,790
- U.S. Patent No. 5,661,591
- U.S. Patent No. 5,740,288
- U.S. Patent No. 5,745,271
- U.S. Patent No. 5,774,244
- U.S. Patent No. 5,835,458
- U.S. Patent No. 5,847,831
- U.S. Patent No. 5,867,264
- U.S. Patent No. 5,868,480
- U.S. Patent No. 5,872,880

- U.S. Patent No. 5,875,272
- U.S. Patent No. 5,881,199
- U.S. Patent No. 5,936,752
- U.S. Patent No. 5,960,133
- U.S. Patent No. 5,943,158
- U.S. Patent No. 5,974,207
- U.S. Patent No. 5,999,306
- U.S. Patent No. 6,069,719
- U.S. Patent No. 6,011,884
- U.S. Patent No. 6,018,603
- U.S. Patent No. 6,028,689
- U.S. Patent No. 6,044,705
- U.S. Patent No. 6,069,719
- U.S. Patent No. 6,081,331
- U.S. Patent No. 6,097,859
- U.S. Patent No. 6,134,042
- U.S. Patent No. 6,134,359
- U.S. Patent No. 6,137,606
- U.S. Patent No. 6,169,624
- U.S. Patent No. 6,172,777
- U.S. Patent No. 6,178,033
- U.S. Patent No. 6,178,284
- U.S. Patent No. 6,193,376
- U.S. Patent No. 6,204,946

- U.S. Patent No. 6,205,269
- U.S. Patent No. 6,222,954
- U.S. Patent No. 6,243,507
- U.S. Patent No. 6,246,818
- U.S. Patent No. 6,253,001
- U.S. Patent No. 6,253,135
- U.S. Patent No. 6,256,430
- U.S. Patent No. 6,259,841
- U.S. Patent No. 6,263,123
- U.S. Patent No. 6,263,127
- U.S. Patent No. 6,263,135
- U.S. Patent No. 6,275,320
- U.S. Patent No. 6,275,623
- U.S. Patent No. 6,285,500
- U.S. Patent No. 6,289,155
- U.S. Patent No. 6,295,154
- U.S. Patent No. 6,300,619
- U.S. Patent No. 6,307,657
- U.S. Patent No. 6,337,753
- U.S. Patent No. 6,343,862
- U.S. Patent No. 6,345,133
- U.S. Patent No. 6,374,008
- U.S. Patent No. 6,381,387
- U.S. Patent No. 6,392,220

- U.S. Patent No. 6,415,070
- U.S. Patent No. 6,415,073
- U.S. Patent No. 6,415,080
- U.S. Patent No. 6,418,250
- U.S. Patent No. 6,424,757
- U.S. Patent No. 6,439,728
- U.S. Patent No. 6,442,307
- U.S. Patent No. 6,453,087
- U.S. Patent No. 6,445,844
- U.S. Patent No. 4,680,645
- U.S. Patent No. 6,498,872
- U.S. Patent No. 6,501,877
- U.S. Patent No. 6,507,421
- U.S. Patent No. 6,538,816
- U.S. Patent No. 6,519,075
- U.S. Patent No. 6,543,286
- U.S. Patent No. 6,549,699
- U.S. Patent No. 6,567,574
- U.S. Patent No. 6,583,934
- U.S. Patent No. 6,600,851
- U.S. Patent No. 6,603,894
- U.S. Patent No. 6,625,340
- U.S. Patent No. 6,635,350
- U.S. Patent No. 6,629,461

- U.S. Patent No. 6,631,222
- U.S. Patent No. 6,634,810
- U.S. Patent No. 6,657,770
- U.S. Patent No. 6,668,108
- U.S. Patent No. 6,687,430
- U.S. Patent No. 6,687,431
- U.S. Patent No. 6,690,885
- U.S. Patent No. 6,694,072
- U.S. Patent No. 6,697,547
- U.S. Patent No. 6,744,173
- U.S. Patent No. 6,760,511
- U.S. Patent No. 6,768,571
- U.S. Patent No. 6,778,739
- U.S. Patent No. 6,792,174
- U.S. Patent No. 6,795,602
- U.S. Patent No. 6,798,941
- U.S. Patent No. 6,798,992
- U.S. Patent No. 6,810,169
- U.S. Patent No. 6,826,349
- U.S. Patent No. 6,842,549
- U.S. Patent No. 6,859,573
- U.S. Patent No. 6,879,750
- U.S. Patent No. 6,898,348
- U.S. Patent No. 6,912,078

- U.S. Patent No. 6,928,244
- U.S. Patent No. 6,950,609
- U.S. Patent No. 6,961,506
- U.S. Patent No. 6,984,917
- U.S. Patent No. 6,989,921
- U.S. Patent No. 7,023,604
- U.S. Patent No. 7,183,633
- U.S. Patent No. 8,233,794
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III. P.R. 3-3(b): PRIOR ART THAT ANTICIPATES OR RENDERS OBVIOUS ONE OR MORE ASSERTED CLAIMS

Subject to Infinera's reservation of rights, Infinera identifies the following combinations of prior art now known to Infinera that render obvious one or more of the Asserted Claims under pre-AIA 35 U.S.C. § 103. Infinera also discloses the motivation to combine such items. Infinera reserves the right to assert that any of the identified prior art anticipates one or more of the Asserted Claims under pre-AIA 35 U.S.C. § 102 depending upon the Court's construction of the Asserted Claims, any findings as to the priority date of the Asserted Claims, and/or positions that Capella or its fact or expert witness(es) may take concerning claim construction, infringement, and/or invalidity issues.

To the extent a cited prior art reference is deemed not to by itself to anticipate or render obvious a claim as noted in the attached charts for failing to teach or suggest one or more

limitations of that claim, that claim would nonetheless have been obvious to one of ordinary skill in the art at the time of the invention by the combination of the cited prior art reference with one or more other prior art references and/or common knowledge disclosing any missing claim limitations. For example, a person of ordinary skill in the art would have been motivated to combine any reference in Table A-1 and/or Table A-2 with any other reference(s) in Table A-1 and/or Table A-2 and/or one or more of the references identified as illustrating the state of the art. The following includes examples of references that would have been combined by one of ordinary skill in the art.

The following combinations are merely examples. Infinera explicitly contends that any of the references identified in Table A-1 and/or Table A-2 and/or the references identified as illustrating the state of the art could be combined to disclose all limitations of the Asserted Claims of the Asserted Patents. Such combinations would be achieved, for example, by merely combining the disclosures documented in the respective claim charts for each reference.

A. Exemplary Combinations

1. Exemplary Combinations Based on Tew ’640 (Charts A/B-1)

Exemplary combinations based on Tew ’640 (Charts A/B-1) include the following:

- **Tew ’640 + Smith**
- **Tew ’640 + Carr**
- **Tew ’640 + Lalonde**
- **Tew ’640 + Hoen**
- **Tew ’640 + Sparks**
- **Tew ’640 + Tomlinson**
- **Tew ’640 + Weverka**

- **Tew ’640 + Kramer**
- **Tew ’640 + Trunta**
- **Tew ’640 + Raj**
- **Tew ’640 + Bouevitch**
- **Tew ’640 + Pan**
- **Tew ’640 + Rose**
- **Tew ’640 + Dragone**
- **Tew ’640 + Tew ’520**
- **Tew ’640 + Tew ’070**
- **Tew ’640 + Dueck**
- **Tew ’640 + Lin**
- **Tew ’640 + Solgaard**
- **Tew ’640 + Yuan**
- **Tew ’640** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Tew ’640** + **Smith** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Carr** + one or more of (**Tew ’520**, **Tew ’070**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’640 + Lalonde** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Smith**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Hoen** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Smith**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Sparks** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Smith**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Tomlinson** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Smith, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Weverka** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Smith, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Raj** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Smith, Rose, Dragone, Dueck, Kramer,**

Trutna, Solgaard, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’640 + Rose** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Smith, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Dragone** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Smith, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Tew ’640 + Kramer** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Smith, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Trutna** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Smith, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Bouevitch** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Smith**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’640 + Lin** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Smith**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Pan** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Smith,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640** + **Tew ’520** + one or more of (**Smith**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640** + **Tew ’070** + one or more of (**Tew ’520**, **Smith**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640** + **Dueck** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Smith, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640** + **Solgaard** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer,**

Trutna, Smith, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew '640** + **Yuan** + one or more of (**Tew '520**, **Tew '070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Smith, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew '640** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew '520**, **Tew '070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Smith, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

2. <u>Exemplary Combinations Based on Tew '520 (Charts A/B-2)</u>

Exemplary combinations based on Tew '520 (Charts A/B-2) include the following:

- **Tew '520** + **Smith**
- **Tew '520** + **Carr**
- **Tew '520** + **Lalonde**
- **Tew '520** + **Hoen**
- **Tew '520** + **Sparks**
- **Tew '520 + Tomlinson**
- **Tew '520 + Weverka**
- **Tew '520 + Kramer**
- **Tew '520 + Trunta**
- **Tew '520 + Raj**
- **Tew '520 + Bouevitch**

- **Tew ’520 + Pan**
- **Tew ’520 + Rose**
- **Tew ’520 + Dragone**
- **Tew ’520 + Tew ’640**
- **Tew ’520 + Tew ’070**
- **Tew ’520 + Dueck**
- **Tew ’520 + Lin**
- **Tew ’520 + Solgaard**
- **Tew ’520 + Yuan**
- **Tew ’520** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Tew ’520** + **Smith** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Carr** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Lalonde** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Smith**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’520 + Hoen** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Smith**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Sparks** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Smith**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Tomlinson** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Smith, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Weverka** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Smith, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Raj** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Smith, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Rose** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Smith, Dragone, Dueck, Kramer, Trutna,**

Solgaard, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’520 + Dragone** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Smith, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Tew ’520 + Kramer** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Smith, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Trutna** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Smith, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Bouevitch** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Smith**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Lin** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Smith**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’520 + Pan** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Smith,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520** + **Tew ’640** + one or more of (**Smith**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520** + **Tew ’070** + one or more of (**Tew ’640**, **Smith**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520** + **Dueck** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Smith, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Smith, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520** + **Yuan** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna,**

Solgaard, Smith, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew '520** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew '640**, **Tew '070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Smith, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

3. Exemplary Combinations Based on Tew '070 (Charts A/B-3)

Exemplary combinations based on Tew '070 (Charts A/B-3) include the following:

- **Tew '070** + **Smith**
- **Tew '070** + **Carr**
- **Tew '070** + **Lalonde**
- **Tew '070** + **Hoen**
- **Tew '070** + **Sparks**
- **Tew '070 + Tomlinson**
- **Tew '070 + Weverka**
- **Tew '070 + Kramer**
- **Tew '070 + Trunta**
- **Tew '070 + Raj**
- **Tew '070 + Bouevitch**
- **Tew '070 + Pan**
- **Tew '070 + Rose**
- **Tew '070 + Dragone**
- **Tew '070 + Tew '640**

- **Tew ’070 + Tew ’520**
- **Tew ’070 + Dueck**
- **Tew ’070 + Lin**
- **Tew ’070 + Solgaard**
- **Tew ’070 + Yuan**
- **Tew ’070** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Tew ’070** + **Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Smith**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Smith**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’070 + Sparks** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Smith**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Smith, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Smith, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Smith, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Smith, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Dragone** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Smith, Dueck, Kramer,**

Trutna, Solgaard, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**

- **Tew ’070 + Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Smith, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Trutna** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Smith, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Smith**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Smith**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Smith,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’070** + **Tew ’640** + one or more of (**Smith**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070** + **Tew ’520**+ one or more of (**Tew ’640**, **Smith**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070** + **Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Smith, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Smith, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Smith, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka,**

Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Smith, Bouevitch, **Lin**, **Pan,** and/or **Yuan**)

4. Exemplary Combinations Based on Smith (Charts A/B-4)

Exemplary combinations based on Smith (Charts A/B-4) include the following:

- **Smith + Tew '070**
- **Smith** + **Carr**
- **Smith** + **Lalonde**
- **Smith** + **Hoen**
- **Smith** + **Sparks**
- **Smith + Tomlinson**
- **Smith + Weverka**
- **Smith + Kramer**
- **Smith + Trunta**
- **Smith + Raj**
- **Smith + Bouevitch**
- **Smith + Pan**
- **Smith + Rose**
- **Smith + Dragone**
- **Smith v+ Tew '640**
- **Smith + Tew '520**
- **Smith + Dueck**
- **Smith + Lin**
- **Smith + Solgaard**

- **Smith + Yuan**
- **Smith** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Smith** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Tew ’070**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Tew ’070**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Sparks** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Tew ’070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Smith + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tew ’070, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Tew ’070, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Tew ’070, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Tew ’070, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Dragone** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Tew ’070, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Smith + Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Tew ’070, Trutna,**

Solgaard, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Smith + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Tew '070, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Tew '070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Lin** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Tew '070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Pan** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Smith** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith** + **Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew ’070, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Tew ’070, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

5. <u>Exemplary Combinations Based on Carr (Charts A/B-5)</u>

Exemplary combinations based on Carr (Charts A/B-5) include the following:

- **Carr + Tew ’070**

- **Carr** + **Smith**
- **Carr** + **Lalonde**
- **Carr** + **Hoen**
- **Carr** + **Sparks**
- **Carr + Tomlinson**
- **Carr + Weverka**
- **Carr + Kramer**
- **Carr + Trunta**
- **Carr + Raj**
- **Carr + Bouevitch**
- **Carr + Pan**
- **Carr + Rose**
- **Carr + Dragone**
- **Carr v+ Tew ’640**
- **Carr + Tew ’520**
- **Carr + Dueck**
- **Carr + Lin**
- **Carr + Solgaard**
- **Carr + Yuan**
- **Carr** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Carr** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer,**

Trutna, Solgaard, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Carr + Smith** + one or more of (**Tew '640**, **Tew '520**, **Tew '070**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Lalonde** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Tew '070**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Hoen** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Tew '070**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Tew '070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Tomlinson** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tew '070, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Carr + Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Tew ’070, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Tew ’070, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Tew ’070, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Dragone** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Tew ’070, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Carr + Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Tew ’070, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Trutna** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Tew**

’070, Solgaard, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Carr + Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Tew ’070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Tew ’070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Carr** + **Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew ’070, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Tew ’070, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

6. <u>Exemplary Combinations Based on Solgaard (Charts A/B-6)</u>

Exemplary combinations based on Solgaard (Charts A/B-6) include the following:

- **Solgaard + Tew ’070**
- **Solgaard** + **Smith**
- **Solgaard** + **Lalonde**
- **Solgaard** + **Hoen**
- **Solgaard** + **Sparks**

- **Solgaard + Tomlinson**
- **Solgaard + Weverka**
- **Solgaard + Kramer**
- **Solgaard + Trunta**
- **Solgaard + Raj**
- **Solgaard + Bouevitch**
- **Solgaard + Pan**
- **Solgaard + Rose**
- **Solgaard + Dragone**
- **Solgaard v+ Tew ’640**
- **Solgaard + Tew ’520**
- **Solgaard + Dueck**
- **Solgaard + Lin**
- **Solgaard + Carr**
- **Solgaard + Yuan**
- **Solgaard** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Solgaard** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer,**

Trutna, Carr, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Solgaard + Lalonde** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Tew '070**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Hoen** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Tew '070**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Tew '070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Tomlinson** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tew '070, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Weverka** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Tew '070, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Solgaard + Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Tew ’070, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Tew ’070, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Dragone** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Tew ’070, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Solgaard + Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Tew ’070, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Trutna** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Tew ’070, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer,**

Trutna, Carr, Yuan, Tew ’070, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Solgaard + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Tew ’070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew ’070, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Solgaard** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Tew ’070, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

7. <u>Exemplary Combinations Based on Dueck (Charts A/B-7)</u>

Exemplary combinations based on Dueck (Charts A/B-7) include the following:

- **Dueck + Tew ’070**
- **Dueck** + **Smith**
- **Dueck** + **Lalonde**
- **Dueck** + **Hoen**
- **Dueck** + **Sparks**
- **Dueck + Tomlinson**
- **Dueck + Weverka**
- **Dueck + Kramer**
- **Dueck + Trunta**

- **Dueck + Raj**
- **Dueck + Bouevitch**
- **Dueck + Pan**
- **Dueck + Rose**
- **Dueck + Dragone**
- **Dueck v+ Tew ’640**
- **Dueck + Tew ’520**
- **Dueck + Solgaard**
- **Dueck + Lin**
- **Dueck + Carr**
- **Dueck + Yuan**
- **Dueck** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Dueck** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Dueck + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Tew ’070**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Sparks** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Tew ’070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tew ’070, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Tew ’070, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Tew ’070, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Dueck + Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Tew ’070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Dragone** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Tew ’070, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Dueck + Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Tew ’070, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Trutna** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Tew ’070, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew ’070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Bouevitch, **Tew '070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Dueck + Pan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck** + **Tew '520** + one or more of (**Tew '640**, **Tew '070**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck** + **Solgaard** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew '070, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck** + **Carr** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Tew '070, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Dueck** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

8. Exemplary Combinations Based on Lalonde (Charts A/B-8)

Exemplary combinations based on Lalonde (Charts A/B-8) include the following:

- **Lalonde + Tew ’070**
- **Lalonde** + **Smith**
- **Lalonde** + **Dueck**
- **Lalonde** + **Hoen**
- **Lalonde** + **Sparks**
- **Lalonde + Tomlinson**
- **Lalonde + Weverka**
- **Lalonde + Kramer**
- **Lalonde + Trunta**
- **Lalonde + Raj**
- **Lalonde + Bouevitch**
- **Lalonde + Pan**
- **Lalonde + Rose**

- **Lalonde + Dragone**
- **Lalonde v+ Tew ’640**
- **Lalonde + Tew ’520**
- **Lalonde + Solgaard**
- **Lalonde + Lin**
- **Lalonde + Carr**
- **Lalonde + Yuan**
- **Lalonde** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Lalonde** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Lalonde + Sparks** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Tew ’070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tew ’070, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Tew ’070, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Tew ’070, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Tew ’070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Lalonde + Dragone** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Tew ’070, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Lalonde + Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Tew ’070, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Trutna** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Tew ’070, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew ’070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Tew ’070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Bouevitch, **Lin**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Lalonde** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew ’070, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Lalonde** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

9. Exemplary Combinations Based on Hoen (Charts A/B-9)

Exemplary combinations based on Hoen (Charts A/B-9) include the following:

- **Hoen + Tew ’070**
- **Hoen** + **Smith**
- **Hoen** + **Dueck**
- **Hoen** + **Lalonde**
- **Hoen** + **Sparks**
- **Hoen + Tomlinson**
- **Hoen + Weverka**
- **Hoen + Kramer**
- **Hoen + Trunta**
- **Hoen + Raj**
- **Hoen + Bouevitch**
- **Hoen + Pan**
- **Hoen + Rose**
- **Hoen + Dragone**
- **Hoen + Tew ’640**
- **Hoen + Tew ’520**
- **Hoen + Solgaard**

- **Hoen + Lin**
- **Hoen + Carr**
- **Hoen + Yuan**
- **Hoen** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Hoen** + **Tew '070** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Smith** + one or more of (**Tew '640**, **Tew '520**, **Tew '070**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Dueck** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Tew '070**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Lalonde** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Tew '070**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Tew '070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Hoen + Tomlinson** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tew '070, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Weverka** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Tew '070, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Raj** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Tew '070, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Rose** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Tew '070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**

- **Hoen + Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Tew ’070, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Trutna** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Tew ’070, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew ’070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Tew ’070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard,**

Kramer, Trutna, Carr, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Hoen** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew ’070, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

10. Exemplary Combinations Based on Sparks (Charts A/B-10)

Exemplary combinations based on Sparks (Charts A/B-10) include the following:

- **Sparks + Tew ’070**
- **Sparks + Smith**
- **Sparks + Dueck**
- **Sparks + Lalonde**
- **Sparks + Hoen**
- **Sparks + Tomlinson**
- **Sparks + Weverka**
- **Sparks + Kramer**
- **Sparks + Trunta**
- **Sparks + Raj**
- **Sparks + Bouevitch**
- **Sparks + Pan**
- **Sparks + Rose**
- **Sparks + Dragone**
- **Sparks + Tew ’640**
- **Sparks + Tew ’520**
- **Sparks + Solgaard**
- **Sparks + Lin**
- **Sparks + Carr**
- **Sparks + Yuan**
- **Sparks + Knowledge of a Person of Ordinary Skill in the Art**

- **Sparks** + **Tew '070** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Smith** + one or more of (**Tew '640**, **Tew '520**, **Tew '070**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Dueck** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Tew '070**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Lalonde** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Tew '070**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Hoen** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Tew '070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Tomlinson** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew '070, Weverka, Raj, Rose, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Sparks + Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Tew ’070, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Tew ’070, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Tew ’070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Dragone** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Tew ’070, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Sparks + Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Tew ’070, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Sparks + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew '070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Lin** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Tew '070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Pan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks** + **Tew '520** + one or more of (**Tew '640**, **Tew '070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard,**

Kramer, Trutna, Carr, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Sparks** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew ’070, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

11. Exemplary Combinations Based on Bouevitch (Charts A/B-11)

Exemplary combinations based on Bouevitch (Charts A/B-11) include the following:

- **Bouevitch + Tew ’070**
- **Bouevitch** + **Smith**
- **Bouevitch** + **Dueck**

- **Bouevitch** + **Lalonde**
- **Bouevitch** + **Hoen**
- **Bouevitch + Tomlinson**
- **Bouevitch + Weverka**
- **Bouevitch + Kramer**
- **Bouevitch + Trunta**
- **Bouevitch + Raj**
- **Bouevitch + Sparks**
- **Bouevitch + Pan**
- **Bouevitch + Rose**
- **Bouevitch + Dragone**
- **Bouevitch + Tew ’640**
- **Bouevitch + Tew ’520**
- **Bouevitch + Solgaard**
- **Bouevitch + Lin**
- **Bouevitch + Carr**
- **Bouevitch + Yuan**
- **Bouevitch** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Bouevitch** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Bouevitch + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Tew ’070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew ’070, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch + Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Tew ’070, Raj, Rose, Dragone, Solgaard,**

Kramer, Trutna, Carr, Yuan, Sparks, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Bouevitch + Raj** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Tew '070, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch + Rose** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Tew '070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Bouevitch + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Tew '070, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Bouevitch + Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew '070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch + Lin** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Tew '070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch + Pan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Tew '520** + one or more of (**Tew '640**, **Tew '070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Solgaard** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew '070,**

Kramer, Trutna, Carr, Yuan, Sparks, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Bouevitch** + **Carr** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Tew '070, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Yuan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Sparks**, **Lin**, **Pan,** and/or **Yuan**)

12. Exemplary Combinations Based on Rose (Charts A/B-12)

Exemplary combinations based on Rose (Charts A/B-12) include the following:

- **Rose + Tew '070**
- **Rose** + **Smith**
- **Rose** + **Dueck**
- **Rose** + **Lalonde**
- **Rose** + **Hoen**
- **Rose + Tomlinson**
- **Rose + Weverka**

- **Rose + Kramer**
- **Rose + Trunta**
- **Rose + Raj**
- **Rose + Sparks**
- **Rose + Pan**
- **Rose + Bouevitch**
- **Rose + Dragone**
- **Rose + Tew ’640**
- **Rose + Tew ’520**
- **Rose + Solgaard**
- **Rose + Lin**
- **Rose + Carr**
- **Rose + Yuan**
- **Rose** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Rose** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Rose + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Tew ’070**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew ’070, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Tew ’070, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Tew ’070, Bouevitch, Dragone, Solgaard,**

Kramer, Trutna, Carr, Yuan, Sparks, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Rose + Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Tew ’070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Dragone** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Tew ’070, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Rose + Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Tew ’070, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Trutna** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Tew ’070, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Sparks** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew ’070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Rose + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Tew ’070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Tew ’070, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer,**

Trutna, Tew ’070, Yuan, Sparks, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Rose** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Lin**, **Pan,** and/or **Rose**)

13. <u>Exemplary Combinations Based on Lin (Charts A/B-13)</u>

Exemplary combinations based on Lin (Charts A/B-13) include the following:

- **Lin + Tew ’070**
- **Lin** + **Smith**
- **Lin** + **Dueck**
- **Lin** + **Lalonde**
- **Lin** + **Hoen**
- **Lin + Tomlinson**
- **Lin + Weverka**
- **Lin + Kramer**
- **Lin + Trunta**
- **Lin + Raj**
- **Lin + Sparks**

- **Lin + Pan**
- **Lin + Bouevitch**
- **Lin + Dragone**
- **Lin + Tew ’640**
- **Lin + Tew ’520**
- **Lin + Solgaard**
- **Lin + Rose**
- **Lin + Carr**
- **Lin + Yuan**
- **Lin** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Lin** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Lin + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Tew ’070**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew ’070, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Tew ’070, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Tew ’070, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Tew ’070, Dragone, Solgaard,**

Kramer, Trutna, Carr, Yuan, Sparks, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Lin + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Lin + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Tew '070, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew '070**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Rose** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Tew '070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Lin + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Tew ’070, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer,**

Trutna, Carr, Tew ’070, Sparks, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Lin** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Rose**, **Pan,** and/or **Yuan**)

14. Exemplary Combinations Based on Pan (Charts A/B-14)

Exemplary combinations based on Pan (Charts A/B-14) include the following:

- **Pan + Tew ’070**
- **Pan** + **Smith**
- **Pan** + **Dueck**
- **Pan** + **Lalonde**
- **Pan** + **Hoen**
- **Pan + Tomlinson**
- **Pan + Weverka**
- **Pan + Kramer**
- **Pan + Trunta**
- **Pan + Raj**
- **Pan + Sparks**
- **Pan + Lin**
- **Pan + Bouevitch**
- **Pan + Dragone**
- **Pan + Tew ’640**

- **Pan + Tew ’520**
- **Pan + Solgaard**
- **Pan + Rose**
- **Pan + Carr**
- **Pan + Yuan**
- **Pan** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Pan** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Pan + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Tew ’070**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew ’070, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Tew ’070, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Tew ’070, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Tew ’070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Dragone** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Tew ’070, Solgaard, Kramer,**

Trutna, Carr, Yuan, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**

- **Pan + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Tew '070, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew '070**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Rose** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Tew '070**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Lin** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Pan** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Tew ’070, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka,**

Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks, **Rose**, **Lin,** and/or **Yuan**)

15. Exemplary Combinations Based on Tomlinson (Charts A/B-15)

Exemplary combinations based on Tomlinson (Charts A/B-15) include the following:

- **Tomlinson + Tew ’070**
- **Tomlinson** + **Smith**
- **Tomlinson** + **Dueck**
- **Tomlinson** + **Lalonde**
- **Tomlinson** + **Hoen**
- **Tomlinson + Pan**
- **Tomlinson + Weverka**
- **Tomlinson + Kramer**
- **Tomlinson + Trunta**
- **Tomlinson + Raj**
- **Tomlinson + Sparks**
- **Tomlinson + Lin**
- **Tomlinson + Bouevitch**
- **Tomlinson + Dragone**
- **Tomlinson + Tew ’640**
- **Tomlinson + Tew ’520**
- **Tomlinson + Solgaard**
- **Tomlinson + Rose**
- **Tomlinson + Carr**

- **Tomlinson + Yuan**
- **Tomlinson** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Tomlinson** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Tew ’070**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tomlinson + Pan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew '070, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Weverka** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tew '070, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Raj** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Tew '070, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Tew '070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Tomlinson + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Tew '070,**

Trutna, Carr, Yuan, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tomlinson + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew '070**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Rose** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Tew '070**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Lin** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tomlinson** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Tew ’070, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Rose**, **Lin,** and/or **Yuan**)

16. Exemplary Combinations Based on Trutna (Charts A/B-16)

Exemplary combinations based on Trutna (Charts A/B-16) include the following:

- **Trutna + Tew ’070**

- **Trutna** + **Smith**
- **Trutna** + **Dueck**
- **Trutna** + **Lalonde**
- **Trutna** + **Hoen**
- **Trutna + Pan**
- **Trutna + Weverka**
- **Trutna + Kramer**
- **Trutna + Tomlinson**
- **Trutna + Raj**
- **Trutna + Sparks**
- **Trutna + Lin**
- **Trutna + Bouevitch**
- **Trutna + Dragone**
- **Trutna + Tew '640**
- **Trutna + Tew '520**
- **Trutna + Solgaard**
- **Trutna + Rose**
- **Trutna + Carr**
- **Trutna + Yuan**
- **Trutna** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Trutna** + **Tew '070** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Trutna + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Tew ’070**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew ’070, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Trutna + Weverka** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tew '070, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Raj** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Tew '070, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Tew '070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Trutna + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Tew '070, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer,**

Tew ’070, Carr, Yuan, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Trutna + Sparks** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew ’070**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Tew ’070**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Trutna** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Tew ’070, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Rose**, **Lin,** and/or **Yuan**)

17. Exemplary Combinations Based on Weverka (Charts A/B-17)

Exemplary combinations based on Weverka (Charts A/B-17) include the following:

- **Weverka + Tew ’070**
- **Weverka** + **Smith**
- **Weverka** + **Dueck**
- **Weverka** + **Lalonde**
- **Weverka** + **Hoen**

- **Weverka + Pan**
- **Weverka + Tomlinson**
- **Weverka + Kramer**
- **Weverka + Trunta**
- **Weverka + Raj**
- **Weverka + Sparks**
- **Weverka + Lin**
- **Weverka + Bouevitch**
- **Weverka + Dragone**
- **Weverka + Tew ’640**
- **Weverka + Tew ’520**
- **Weverka + Solgaard**
- **Weverka + Rose**
- **Weverka + Carr**
- **Weverka + Yuan**
- **Weverka** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Weverka** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard,**

Kramer, Trutna, Carr, Yuan, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Weverka + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Tew ’070**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew ’070, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tew ’070, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Weverka + Raj** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Tew '070, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Tew '070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Weverka + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Tew '070, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard,**

Kramer, Trutna, Carr, Yuan, Tew '070, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Weverka + Rose** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Tew '070**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Lin** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka** + **Tew '520** + one or more of (**Tew '640**, **Tew '070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka** + **Solgaard** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Tew '070, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Weverka** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Carr, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka** + **Knowledge of a Person of Ordinary Skill in the Art**)+ one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Rose**, **Lin,** and/or **Yuan**)

18. Exemplary Combinations Based on Raj (Charts A/B-18)

Exemplary combinations based on Raj (Charts A/B-18) include the following:

- **Raj + Tew ’070**
- **Raj** + **Smith**
- **Raj** + **Dueck**
- **Raj** + **Lalonde**
- **Raj** + **Hoen**
- **Raj + Pan**
- **Raj + Tomlinson**
- **Raj + Kramer**
- **Raj + Trunta**

- **Raj + Yuan**
- **Raj + Sparks**
- **Raj + Lin**
- **Raj + Bouevitch**
- **Raj + Dragone**
- **Raj + Tew ’640**
- **Raj + Tew ’520**
- **Raj + Solgaard**
- **Raj + Rose**
- **Raj + Carr**
- **Raj + Weverka**
- **Raj** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Raj** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer,**

Trutna, Carr, Weverka, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Raj + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Tew ’070**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew ’070, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tew ’070, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Tew ’070, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Raj + Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Tew ’070, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Dragone** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Tew ’070, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Raj + Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Tew ’070, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Trutna** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Tew ’070, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Sparks** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Tew ’070**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer,**

Trutna, Carr, Weverka, Sparks, **Tew ’070**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Raj + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Tew ’070, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Raj** + **Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Rose**, **Lin,** and/or **Weverka**)

B. Motivations to Combine

The Asserted Claims do not represent innovation over the prior art, but instead would be no more than the result of ordinary skill and common sense. No showing of a specific motivation is required to combine the prior art (including the references disclosed above), as each combination would not have produced unexpected results, and at most would simply represent a known alternative to one of skill in the art. See *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 414-17 (2007). Indeed, the Supreme Court held that a person of ordinary skill in the art is “a person of ordinary creativity, not an automaton” and “in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle.” *Id.* at 420. Regardless, motivation to combine or reasons to modify the teachings of the prior art references disclosed herein (including to form the specific exemplary combinations identified above in Section III.A) is found in at least the following: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art according to known methods; (5) the predictable results obtained in simple

substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces. The following analysis provides various examples of how these motivations may be specifically applied. This following analysis is not limiting, and goes beyond the disclosure required by Patent L.R. 3-3(b). Infinera reserves the right to present various other examples that fall under the motivations identified above.

1. The Nature of the Problem Being Solved

For example, a person of ordinary skill in the art would have been motivated to combine or modify the prior art (including to form the specific exemplary combinations identified above in Section III.A) based on the nature of the problem being solved. The following are merely examples. To the extent additional relevant sources—such as the Asserted Patents, the prosecution history, or testimony or documents provided by named inventors or companies involved in the development of the technology described in the Asserted Patents—identify additional problems that were allegedly being solved, Infinera reserves the right to rely on such problems that were allegedly being solved.

The Asserted Patents identify a number of alleged problems with the prior art, including, for example, (1) alleged high cost (*see, e.g.*, '905 Patent at 2:27–29), (2) alleged optical loss accumulation (*see, e.g.*, *id.*), (3) an alleged inherent difficulty to perform dynamic reconfiguration (*see, e.g.*, *id.* at 2:29–31), (4) an alleged requirement that certain signals and channels share ports, such as an input signal and a pass-through signal, and add channels and

drop channels (*see, e.g.*, *id.* at 2:57–63), (5) an alleged requirement for optical circulators (*see, e.g.*, *id.*), (6) an alleged requirement for additional means to "multiplex the add channels before entering the system and to demultiplex the drop channels after exiting the system[]" (*see, e.g.*, *id.* at 2:63–3:2), (7) unnecessary cost and complexity (*see, e.g.*, *id.*), (8) an alleged requirement for precise alignment (*see, e.g.*, *id.* at 3:5–7), (9) an alleged inability to maintain alignment (*see, e.g.*, *id.* at 3:7–8), (10) an alleged lack of mechanisms for "overcoming degradation in the alignment owing to environmental effects such as thermal and mechanical disturbances over the course of operation" (*see, e.g.*, *id.* at 3:7–11), and (11) an alleged lack of "a systematic and dynamic power management of the power levels of various spectral channels" (*see, e.g.*, *id.* at 3:54–56). A person of ordinary skill in the art would have been motivated to modify or combine the prior art (including to form the specific exemplary combinations identified above in Section III.A) to solve on one or more of these alleged problems. A person of ordinary skill would have been similarly motivated to modify or combine the prior art to achieve a "simple, effective, and economical construction." *See, e.g.*, *id.* at 3:59–61.

2. The Express, Implied and Inherent Teachings of the Prior Art

As another example, a person of ordinary skill would have been motivated to combine or modify the disclosed prior art (including to form the exemplary combinations identified above in Section III.A) based on the express, implied and inherent teachings of the prior art. The following are merely examples of teachings in the prior art, and Infinera also incorporates its claim charts (which specifically compare the teachings of the prior art to the limitations of the Asserted Claims) by reference. To the extent the prior art, including the prior art identified throughout these Contentions, provides additional teachings, Infinera reserves the right to rely on such teachings. Additionally, Infinera reserves the right to rely on passages from the prior art beyond those explicitly quoted or cited below.

For example, the prior art recognized that "[p]urely optical switching, in which the optical beam of the first fiber is coupled directly to a second fiber without significant loss, is much faster" than "mechanical switches," which were typically "slow, large, and very expensive." *See, e.g.*, *Tew '640* at 1:43–55; *see also, e.g.*, *Tew '520* at 1:43–55; *Lalonde* at 1:46–53. The prior art also recognized that "point-to-point" designs using electrical switches did "not integrate well" into "complex network[s]" and that the resulting "number of optical receivers and transmitters" was "very expensive" (*see, e.g.*, *Smith* at 2:43–52), as were the requisite converters (*see, e.g.*, *Lalonde* at 1:46–52). A person of ordinary skill in the art would have been motivated to combine or modify the prior art in ways that (1) allowed for or moved in the direction of purely optical switching, (2) eliminated electrical/mechanical switches, (3) eliminated conversions from the optical domain to the electrical domain (and vice-versa), and/or (4) minimized optical loss. As another example, the prior art recognized a desire for optical switching that was "low-cost, reliable, and optically efficient[,]" (*see, e.g.*, *Tew* '540 at 3:26–7), and a person of ordinary skill in the art would have been motivated to combine or modify the prior art in ways to achieve those goals. The prior art also that "there [wa]s much interest in all-optical communication networks in which each switching node demultiplexes the multi-wavelength WDM signal from an input fiber into its wavelength components, spatially switches the separate single-wavelength beams in different directions, and multiplexes the switched optical signals for retransmission on one or more output fibers." *See, e.g.*, *Smith* at 2:60–66; *see also, e.g.*, *Hoen* at 1:10–19. A person of ordinary skill in the art would have been motivated to combine or modify the prior art in ways to develop such switching nodes, including but not limited to combining different or modifying prior art references that are directed to or otherwise disclose wavelength-division multiplexing or optical add-drop multiplexers, or combining or

modifying prior art to ultimately arrive at a WDM or OADM. The prior art also taught that various disclosures of optical-switching devices (such as WDMs or OADMs) could be modified to different numbers of "input and output fibers" and to use different numbers of "WDM wavelengths." *See, e.g.*, *Smith* at 5:19–21; *see also, e.g.*, *Lalonde* at 5:34–39, 58–62. A person of ordinary skill in the art would have been motivated to combine or modify prior art teachings to either increase or decrease a number of disclosed input and/or output fibers (for example, adding add and/or drop ports). A person of ordinary skill in the art would have also been motivated to combine or modify prior art teachings to handle different numbers of WDM wavelengths. The prior art also taught that the architectures of various types of disclosures of optical switching (such as, for example, optical cross connects or diffraction grating devices) could be applied to other types of disclosures of optical switching (such as OADMs) (*see, e.g.*, *Smith* at 8:46–59; *see also, e.g.*, *Carr* at 11:11–13; *Lalonde* at 5:17–28; *Rose* at 12:21–22), and a person of ordinary skill would have been motivated to combine or modify the prior art to incorporate disclosures from one type of optical switching (such as optical cross connects) to other types of optical switching (such as OADMs), including but not limited to forming combinations or modifications that would have added add and/or drop ports, or modified existing ports to make them add and/or drop ports.

The prior art also recognized that optical-switching devices (such as WDMs or OADMs) could utilize "additional components" "at the discretion of the optical designer" beyond what is specifically disclosed by any single prior art reference. *See, e.g.*, *Tew '640* at 10:22–25. Indeed, "many variations" of disclosed prior art embodiments were possible. *See, e.g.*, *Smith* at 14:32–33. Examples of components that could be added included but were not limited to "focusing optics" placed between input fibers and wavelength separators, between wavelength combiners

and output fibers, and between a mirror array and separators or combiners. *See, e.g.*, *id.* at 10:25–28. The prior art also recognized that multiples of certain components could be used, such as, for example, multiple focusing lenses. *See, e.g.*, *Rose* at 14:49–50. The prior art also recognized that the optical designer had discretion to use substitute components in optical-switching devices (such as WDMs or OADMs) or to use duplicative or multiple components. Examples of such substitute or duplicative components included but were not limited to a single diffraction grating or prism that could replace separators and combiners, or vice versa. *See, e.g.*, *Smith* at 10:28–34. Indeed, the prior art recognized that "wavelength multiplexers and demultiplexers" could be "accomplished in a number of ways typically including dispersive elements such as Bragg gratings, thin-film interference filter arrays, and arrayed waveguide gratings (AWGs) that spatially separate wavelength components." *See, e.g.*, *id.* at 3:45–50. A person of ordinary skill in the art would have recognized that they could add or substitute components from optical-switching devices (such as WDMs or OADMs) at their discretion, combining various components from the prior art to arrive at their desired optical switching-device. As another example, the prior art also recognized a desire to have a single device with "an optical arrangement suitable for both dynamic gain equalizer (DGE) and configurable optical add/drop multiplexer (COADM) applications" (*see, e.g.*, *Bouevitch* at 1:50–57), and a person of ordinary skill would have been motivated to combine or modify the prior art to arrive at such an optical arrangement. As another example, the prior art recognized a desire to make optical switching devices (such as dynamic gain equalizers and configurable optical add/drop multiplexers) more compact, (*see, e.g.*, *id.* at 1:58–2:21), and a person of ordinary skill would have been motivated to combine or modify the prior art to arrive at such an optical arrangement. As another example, the prior art recognized, in at least certain circumstances, the importance of placing certain

optical components—including but not limited to elements having optical power (such as, for example, lenses or spherical mirrors), dispersive or diffraction elements (such as, for example, diffraction gratings), and modifying means (such as, for example, MEMs arrays)—"about one focal length away from each other" (*see, e.g.*, *id.* at 10:22–33, 11:50–58), and a person of ordinary skill would have been motivated to combine or modify the prior art to arrive at such an optical arrangement. As another example, the prior art recognized that a lens has a reflector coincident with a first focal plane, and a diffraction grating coincident with a second focal plane. *See*, *e.g.*, *Bouevitch* at 13:58-64; *see also*, *e.g.*, *Lalonde* at 8:46-51 (discussing demultiplexed wavelengths directed on a MEMS mirror array). A person of ordinary skill would have been motivated to combine or modify the prior art to make an embodiment "compatible with modifying means based on MEMS technology, for both COADM and DGE applications." *See*, *e.g.*, *Bouevitch* at 13:65-14:1.

The prior art also recognized that it was "well understood by those in the art" that "wave plates" (such as quarter- or half-wave plates) could be inserted, for example, "so as to substantially eliminate polarization dependence within the switch." *See, e.g.*, *Smith* at 5:39–42; *see also, e.g.*, *Solgaard* at 8:18–20; *Bouevitch* at 5:49–60, 7:23–44. A person of ordinary skill would have been motivated to combine or modify prior art disclosures to include wave plates, such as quarter- or half-wave plates to, for example, substantially eliminate polarization dependence or sensitivity.

The prior art also recognized that a first "partially demultiplexed signal array" can be collimated and directed to a grating "where they are reflected and diffracted" to form a "resulting two-dimensional reflected and diffracted signal[]" to form a "demultiplexed signal array." *See*, *e.g.*, *Dragone* at 3:66-4:11; *see also*, e.g., *Dragone* at 3:23-41 ("demultiplexing by imaging all of

the partial demultiplexed output port signal of the AWG through a planar diffraction grating onto the final demultiplexed output plane, creating a two-dimensional (2-D) array spots with the fully demultiplexed wavelengths"); *see also*, e.g., *Weverka* at 13:47-59 (discussing a pair of wavelength routers in a back-to-back configuration). A person of ordinary skill would be motivated to combine or modify the prior art to have an auxiliary wavelength separating-routing apparatus by partially and then fully demultiplexing signals, because "partial demultiplexing characteristic of an arrayed waveguide router (AWR) can, advantageously, be combined with a free-space optical router to fully demultiplex an input WDM signal. The two-stage router can be used to obtain output wave length signals in either one- or two-dimensional arrays." *See*, *e.g.*, *Dragone* at 1:36-41.

The prior art also recognized that holding an optical fiber in a ferrule with a collimator lens, such as a self-focusing gradient index (GRIN) lens (what the Asserted Patents arguably identify as at least one example of "a fiber collimator" *see, e.g.*, '905 Patent at 9:34–38) "simplifies handling of the optical fibers." *See, e.g.*, *Tew '520* at 5:45–50. The prior art similarly recognized that "[c]ollimated light is desired due to the typically small mirror tilt angle provided by common micromirror devices." *See, e.g.*, *id.* at 5:49–51. A person of ordinary skill would have therefore been motivated to combine or modify the prior art to include such fiber collimators (replacing components rendered unnecessary, duplicative, and/or obsolete by such fiber collimators), and to include such fiber collimators specifically in the form of "fiber collimator ports" or fiber collimators "serving as" ports (replacing components rendered unnecessary, duplicative, and/or obsolete by such fiber collimator ports, including other types of ports or components using other types of ports). As another example, the prior art also recognized that input and output fibers (including, for example, add and drop fibers) could be

"arranged in, a variety of ways," including placing them side by side, placing one over or under another, and using the same fiber for different paths, the latter arrangement using equipment such as an optical circulator to separate signals." *See, e.g.*, *Solgaard* at 9:14–20. A person of ordinary skill would have been motivated to combine or modify the prior art to accomplish any such fiber arrangements, including, for example, taking a system that uses the same fiber for different paths with an optical circulator, adding fibers (if necessary), separating the paths onto different fibers (arranged, for example, side by side), and removing any optical circulators. *See, e.g.*, *Kramer* at 34:20-28.

As another example, the prior art also recognized that "a more integrated design" "includes the wavelength multiplexing and MEMS switching in a single unit" where "[t]wo input fiber waveguides … and two output fiber waveguides … are aligned linearly parallel to each other." *See*, *e.g.*, *Smith* at 4:16-24 and Fig. 5; *see also*, *e.g.*, *Carr* at Fig. 1B; *Pan* at Fig. 11A; *Solgaard* at 9:13-15; *Raj* at 4:45-52; *Tew '520* at 8:58-9:4, Figs. 5-6, and Fig. 10; *Tew '640* at 8:44-55 and Figs. 4-8. A person of ordinary skill would be motivated to combine or modify the prior art to have a one-dimensional array of input and output ports such that "the ultimate disposition of each channel on each fiber … may be controlled by the MEMS element … to specifically direct or route each input channel to a particular output fiber" with "relatively high precision" and "compact arrangement." *See*, *e.g.*, *Raj* at 4:45-52.

As another example, the prior art also recognized that micromirror arrays "provide[] precise adjustment of . . . power levels[.]" *See, e.g.*, Tew '070, ¶ 35–38; *see also, e.g.*, *Carr* at 11:11–12:50). The prior art recognized that, although one could use "optical amplifiers" to "amplify optical signals and compensate loss," "the amplify the entire WDM signal and their gain spectrum is typically not flat[,]" which would motivate a person of ordinary skill in the art

to combine or modify the prior art to "maintain the power levels of different signals", including to maintain them such that they are "the same or at least in predetermined ratios." *See, e.g.*, *Smith* at 6:18–23. The prior art also recognized the importance of dynamically controlling power levels and implementing feedback control to, for example, "maintain a significant degree of uniformity of power levels across the WDM spectrum," and to account for "internal variations of optical characteristics and misalignments" and "mechanical stress," (*see, e.g.*, *id.* at 6:24–50; *see also, e.g.*, *Rose* at 11:37–41), and a person of ordinary skill in the art would have been motivated to combine or modify the prior art to implement feedback control to control power levels and to dynamically control power levels. The prior art also recognized the importance of monitoring "the power levels for the individual WDM wavelength channels" and/or [i]nput power" "for each wavelength channel" in dynamically controlling power levels and implementing feedback control (*see, e.g.*, *Smith* at 7:25–30; *see also, e.g.*, *Carr* at 11:11–12:50), and a person of ordinary skill would have been motivated to combine or modify the prior art to do so in order to dynamically control power levels and implement feedback control. The prior art also recognized that power levels could be adjusted by, for example, (1) the number of mirrors used, (2) the angle of the mirrors, and (3) the location of the mirrors (*Tew '070*, ¶ 37; *see also, e.g.*, *Smith* at 6:55–57, 7:32–44, 7:49–52; *Carr* at 11:11–12:50), and a person of ordinary skill in the art would have been motivated to combine or modify the prior art to use any or all of these techniques. The prior art also recognized that the angle of the mirrors was particularly important when the mirrors were operated in an analog mode, as opposed to a digital mode. *See, e.g.*, *Tew '070*, ¶ 37. A person of ordinary skill would have been motivated to combine or modify prior art disclosures of micromirror arrays to adjust for power levels (to the extent adjusting for power levels was not already taught or accounted for by a prior art disclosure). The prior art also recognized that

adjusting power levels could be accomplished by monitoring signal strength, and that the monitoring could be accomplished by internal or external sources (*see, e.g.*, *id.*, ¶¶ 45–46; *see also, e.g.*, *Smith* at 13:39–55). The prior art also recognized that it was "desirable to integrate" into optical networks systems that utilized arrays of mirrors (or beam deflecting elements) that were tiltable about two axes, at least so as to dynamically control power levels. *See, e.g.*, *Smith* at 6:51–61 (describing U.S. Patent No. 6,263,123 to Bishop et al.). A person of ordinary skill in the art would have not only been motivated to combine or modify the prior art so as to dynamically control power levels and implement feedback control but would have been specifically been motivated to combine or modify the prior art to incorporate arrays of mirrors tiltable about two axes to do so. The prior art also recognized that one particularly desirable way of monitoring power levels was to "monitor the intensities of WDM channels" "with the main emphasis on determining the ratio of signal to noise (*see, e.g.*, *Smith* at 6:61–67 (citing U.S. Patent No. 4,796,479 to Derickson et al.); *see also, e.g.*, *Sparks* at 1:11–25), and a person of ordinary skill would have been motivated to combine or modify the prior art to monitor signal intensities and determine signal-to-noise ratios in the process of performing dynamic power control and feedback control. The prior art also recognized "several criteria for adjusting relative power between channels," including, for example, matching intensity between channels and pre-emphasizing certain intensities of channels (*see, e.g.*, *Smith* at 9:58–10:12), and a person of ordinary skill in the art would have been motivated to combine or modify the prior art to incorporate such criteria in the process of performing dynamic power control and feedback control. The prior art also recognized that feedback control and dynamic power control did not require "the use of free-space optics . . . for the dispersion, the switching, or the power adjustment" (*see, e.g.*, *id.* at 19:56–59), and a person of ordinary skill in the art would have been

motivated to modify or combine prior art disclosures both utilizing and not utilizing free-space optics to implement feedback control and dynamic power control. The prior art also recognized that "each of the channels passing through [a] switch may be attenuated to whatever degree necessary to achieve the desired effect, e.g., equalization of optical power across all channels" (*see, e.g.*, *Sparks* at 2:33–36), and a person of ordinary skill in the art would have been motivated to combine or modify prior art disclosures involving feedback control or dynamic power control to achieve any desired effect, including, for example, equalization across all or a subgroup of channels. The prior art also taught that, at least in certain circumstances, it was advantageous to use feedback control or dynamic power control to "provide a predetermined optical output power" (*see, e.g.*, *Sparks* at 3:38–44) or "a predetermined ratio of output optical power between at least any two of said different wavelength optical signals" (*id.* at 3:4–9), and a person of ordinary skill would have been motivated to combine or modify prior art disclosures involving feedback control or dynamic power control to maintain a predetermined power or a predetermined power ratio compared to other optical signals.

As another example, the prior art also recognized that "a fundamental control mechanism" of "optical switches based on tilting mirrors is the degree of coupling" between components (*see, e.g.*, *Smith* at 16:53–65), and a person of ordinary skill would have been motivated to combine or modify the prior art to monitor the degree of coupling (or, for example, a coupling efficiency) between components and to performing feedback control and dynamically control power levels based on the degree of coupling (or, for example, a coupling efficiency) or to adjust a degree of coupling (or, for example, a coupling efficiency), such as to achieve or maintain a desired degree of coupling (or, for example, a coupling efficiency). The prior art also recognized "two principal types of alignment or mismatch," namely, "positional mismatch" or

"angular mismatch" (*see, e.g.*, *id.* at 17:24–52), and a person of ordinary skill in the art would have been motivated to combine or modify the prior art to either account for this alignment or mismatch or to intentionally use this alignment or mismatch (*see, e.g.*, *id.* at 18:54–57; *see also, e.g.*, *Carr* at 12:1–5; *Sparks*, Abstract) to, for example, implement dynamic feedback control or dynamically control power levels. The prior art also recognized the distinction between "power tuning or equalization" and "calibration tuning" (*see, e.g.*, *Smith* at 18:32–41), and a person of ordinary skill in the art would have been motivated to combine or modify the prior art to not only utilize feedback control and dynamic power control, but to use such control for power tuning or equalization and/or calibration tuning (or, for example, to modify disclosures feedback control dynamic power control focused on power tuning or equalization to focus on calibration tuning, and vice-versa).

As another example, the prior art recognized that, while circulators could be used in various systems, they could be replaced by, for example, "[a]ny light separation device[.]" *See, e.g.*, *Tew '070*, ¶ 39. Such a light separation device included "a diffraction grating, prism, or other optical component." *See, e.g.*, *id.*, ¶ 40. The prior art also recognized that circulators were "bulky" and "costly." *See, e.g.*, *Bouevitch* at 13:5–6; U.S. Patent No. 5,960,133 at 4:3-4 ("Circulators are expensive and add loss.") *See also, e.g.*, *Kramer* at 33:56-34:2 and 34:20-28. Accordingly, a person of ordinary skill in the art would have been motivated to combine or modify prior art disclosures to replace or eliminate circulators and, if necessary, replace them with more ideal components such as, for example, other light separation devices.

As another example, the prior art recognized that any number of "fabrication processes" could be used to create MEMs micromirrors that could be used even if they resulted in "somewhat different structures" (*see, e.g.*, *Smith* at 14:65–15:5) because it would not impact the

operation of the overarching method, apparatus, or system. A person of ordinary skill would have been motivated to combine or modify the prior art even if disclosed MEMs micromirrors were somehow different or had different structures.

As another example, to the extent various pieces of prior art directly referred to one another, a person of ordinary skill in the art would have been motivated to combine or modify those prior art references, or to combine or modify references with similar disclosures. *E.g., Smith* at 3:66-4:24 (referencing *Solgaard*).

As another example, to the extent various pieces of prior art shared a named inventor or shared an assignee, a person of ordinary skill in the art would have been motivated to combine or modify those prior art references, or to combine or modify references with similar disclosures.

3. The Knowledge of Persons of Ordinary Skill in the Art

As another example, a person of ordinary skill in the art would have been motivated to combine or modify any of the disclosed prior art ((including to form the specific exemplary combinations identified above in Section III.A) because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references. Such features include, but are not limited to, the following:

- Optical add-drop apparatuses and methods of performing dynamic add and drop in WDM optical networks;
- Wavelength-separating-routing apparatuses, including auxiliary wavelength-separating-routing apparatuses;
- Receiving a multi-wavelength optical signal;

- Fiber collimator ports or fiber collimators serving as ports, including but not limited to fiber collimator input, output, add, drop, and pass-through ports;
- One- or two-dimensional arrays of ports, including fiber collimator ports or fiber collimators serving as ports;
- Wavelength-selective devices or wavelength separators for spatially separating spectral channels, including but not limited to (1) ruled diffraction gratings, (2) holographic diffraction gratings, (3) echelle gratings, (4) curved diffraction gratings, (5) dispersing prisms, and (6) dispersing gratings;
- Beam-deflecting elements or channel micromirrors, including beam-deflecting elements or channel micromirrors that (1) each receive a corresponding spectral channel, (2) are individually controllable, (3) are continuously controllable, (4) are dynamically controllable (5) are controllable in two dimensions; (6) are pivotable about two axes; (7) reflect a spectral channel to different ports, such as output ports, drop ports, pass-through ports, or exiting ports; and/or (8) control the power of a corresponding spectral channel;
- Spatial arrays of beam-deflecting elements or channel micromirrors, including special arrays of beam-deflecting elements or channel micromirrors that reflect subsets of certain spectral channels to certain ports, as output ports, drop ports, pass-through ports, or exiting ports;
- Imaging spectral channels onto beam-deflecting elements or channel micromirrors;
- Focusing spectral channels onto beam-deflecting elements or channel micromirrors;

- Control units for beam-deflecting elements or channel micromirrors, including control units that cause beam-deflecting elements or channel micromirrors to direct spectral channels to certain ports and/or to control power levels;
- Servo-control assemblies;
- Spectral monitors, including spectral monitors for monitoring power levels of spectral channels, and other methods of and devices for monitoring power levels of spectral channels;
- Processing units for controlling beam-deflecting elements or channel micromirrors, including processing units responsive to power levels;
- Servo-control assemblies (or other assemblies or devices) or feedback controls, including servo-control assemblies or feedback controls that (1) maintain power levels at predetermined values, (2) provide control for beam-deflecting elements or channel micromirrors, (3) maintain a predetermined coupling efficiency for all and/or certain spectral channels, including spectral channels being directed to a certain port, (4) maintain a predetermined coupling for all and/or certain spectral channels, including spectral channels being directed to a certain port, (5) monitor power levels of all and/or certain spectral channels, including spectral channels being directed to a certain port, (6) include a spectral monitor, and/or (7) include a processing unit.
- Alignment mirrors or collimator-alignment mirrors, including alignment mirrors or collimator-alignment mirrors that (1) are in optical communication with a wavelength-separator and one or more certain ports and/or (2) adjust alignment of, input signals, output signals, and/or individual spectral channels or groups of

spectral channels, and/or (3) direct reflected spectral channels into certain ports, such as output ports, drop ports, pass-through ports, or exiting ports;

- Arrays of alignment mirrors or collimator-alignment mirrors, including one-dimensional arrays;
- Combining or multiplexing spectral channels to form a multi-wavelength optical signal;
- Beam-focusers for focusing separated spectral channels onto beam deflecting elements or channel micromirrors, including (1) beam-focusers comprising a focusing lens having first and second focal points and/or (2) beam-focusers comprising one or more or an assembly of lenses;
- Placing a wavelength-separating apparatus or wavelength-separator at a first focal point of a focusing lens, and placing beam-deflecting elements or channel micromirrors at a second focal point of a focusing lens;
- Micromachined mirrors, including silicon micromachined mirrors;
- Micromirrors;
- Not using or otherwise passing certain signals or spectral channels through circulators;
- Power-management systems, including power-management systems configured to (1) manage power levels of certain spectral channels and/or (2) control coupling efficiency between spectral channels and ports;
- Controlling an alignment between an input multi-wavelength optical signal and corresponding beam deflecting elements based on monitoring power levels for certain spectral channels;

- Beam-focusers, including beam-focusers for focusing spectral channels onto corresponding spectral spots;
- Quarter-wave plates, including quarter-wave plates optically interposed between wavelength-selective devices or wavelength separators and beam-deflecting elements or channel micromirrors; and
- Optical sensors, including optical sensors optically coupled to one or more certain ports, including drop ports, output ports, pass-through ports, or exiting ports.

4. <u>The Predictable Results Obtained in Combining the Different Elements of the Prior Art According to Known Methods</u>

As another example, a person of ordinary skill in the art would have been motivated to form combinations based on any of the disclosed prior art to include features omitted from any single prior art reference or combination of references because doing so would have generated predictable results and could have been accomplished according to known methods. Such features include, but are not limited to, the each of the features identified in Section III.B.3., above.

5. <u>The Predictable Results Obtained in Simple Substitution of One Known Element for Another</u>

As another example, a person of ordinary skill in the art would have been motivated to combine or modify the prior art (including to form the specific exemplary combinations identified above in Section III.A) because doing so would have involved substituting one feature for another feature known in the art and would have generated predictable results. Such features that could have been added by substitution include, but are not limited to, each of the features identified in Section III.B.3., above.

6. <u>The Use of a Known Technique to Improve Similar Devices, Methods, or Products in the Same Way</u>

As another example, a person of ordinary skill in the art would have been motivated to combine or modify the prior art (including to form the specific exemplary combinations identified above in Section III.A), because doing so would have used known features to improve similar devices, methods, or products (including but not limited to devices, methods, or products in or related to the field of optical switching) in the same way, and would have generated predictable results. Such features include, but are not limited to, the each of the features identified in Section III.B.3., above.

7. <u>The Predictable Results Obtained in Applying a Known Technique to a Known Device, Method, or Product Ready for Improvement</u>

As another example, a person of ordinary skill in the art would have been motivated to combine or modify the prior art (including to form the specific exemplary combinations identified above in Section III.A), because doing so would have involved applying a known technique to improve a known device, method, or product (including but not limited to devices, methods, or products in or related to the field of optics or optical switching), and would have generated predictable results. Such features include, but are not limited to, the each of the features identified in Section III.B.3., above.

8. <u>The Finite Number of Identified Predictable Solutions that Had a Reasonable Expectation of Success</u>

As another example, a person of ordinary skill in the art would have been motivated to combine or modify the prior art (including to form the specific exemplary combinations identified above in Section III.A) because doing so would have been obvious to try. Specifically, a person of ordinary skill in the art would have recognized that, within the field of optics or optical switching (for example), there were a finite number of identified, predictable potential

features that could solve a recognized need or problem, and a person of ordinary skill in the art would have pursued incorporating these known features with a reasonable expectation of success. Such features include, but are not limited to, the each of the features identified in Section III.B.3., above.

9. Known Work in Various Technological Fields that Could Be Applied to the Same or Different Technological Fields Based on Design Incentives or Other Market Forces

As another example, a person of ordinary skill in the art would have been motivated to combine or modify the prior art (including to form the specific exemplary combinations identified above in Section III.A), including the prior art references, which are in the same field of the Asserted Patents and each other (such as optics or optical switching, including for multi-wavelength WDM communications), or in a different field, to include various features because doing so would have been prompted by design incentives or market forces, variations or principles applying such features that were known in the prior art, and doing so would have generated predictable results. Such design incentives or market forces included but were not limited to those identified by the Asserted Patents themselves and the prior art (discussed above in Sections III.B.1–III.B.8). Such features include, but are not limited to, the each of the features identified in Section III.B.3., above.

10. Previously Identified Motivations to Combine

As another example, Capella has been put on notice of other motivations to combine, via previously served invalidity contentions (*see, e.g.*, Defendants Coriant (USA), Inc.'s and Columbus Networks USA, Inc.'s Preliminary Invalidity Contentions, *Capella Photonics, Inc. v. Tellabs, Inc.*, 14-CIV-60350 (S.D. Fla. June 16, 2014) (Dkt. 62) and via *inter partes* review proceedings before the Patent Trial and Appeal Board (*see, e.g.*, *Cisco Sys., Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368,

IPR2014-01166 (PTAB July 15, 2014); *Cisco Sys., Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,678, IPR2014-01276 (PTAB Aug. 12, 2014); *Fujitsu Network Comm'ns, Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2015-00726 (PTAB Feb. 12, 2015); *Fujitsu Network Comm'ns, Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,678, IPR2015-00727 (PTAB Feb. 12, 2015); *JDS Uniphase Corp. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2015-00731 (PTAB Feb. 13, 2015); *JDS Uniphase Corp. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,678, IPR2015-00739 (PTAB Feb. 14, 2015); *Ciena Corp. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2015-00816 (PTAB Feb. 26, 2015); *Ciena Corp. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,678, IPR2015-00894 (PTAB Mar. 17, 2015); *Ciena Corp. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2015-01958 (PTAB Sep. 24, 2015); *Ciena Corp. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,678, IPR2015-01961 (PTAB Sep. 24, 2015); *Coriant Operations, Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2015-01969 (PTAB Sep. 25, 2015); *Coriant Operations, Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,678, IPR2015-01971 (PTAB Sep. 25, 2015)). At least some of these motivations to combine are identical to or fall within the motivations to identify already identified above. Infinera contends that these previously identified motivations to combine with respect to the '368 and '678 Patents are also applicable to the Asserted Patents for at least the prior art identified in these Contentions and the specific combinations identified

above in Section III.A, to the extent the prior art contains the same or similar features as those identified in the discussions of the specific prior art references below.

a. Use of 2-Axis Mirrors, Both for Switching and Power Control

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to use 2-axis mirror for switching and power control for at least the following reasons stated in previously served invalidity contentions:

> The use of MEMS technology in fiber-optic components for equalization and switching was well known by 1999. E.g., U.S. Patent No. 5,745,271; U.S. Patent No. 6,097,859. For example, an early use of MEMS technology for optics was the Texas Instruments (TI) Deformable Mirror Device (DMD) (also known as the Digital Mirror Device). The basic technology was developed in the 1980s, and had reached volume production in the early 1990s for projection displays called Digital Light Projectors (DLP). The TI Optical MEMS display used a silicon chip covered with tiny mirrors that could be electrically controlled and rotated. See U.S. Patent Application Publication No. 2002/0081070. With the drive toward more efficient MEMS devices (including ROADMs), certain investigators had come to understand the limitations of 1-axis MEMS mirrors and that 2-axis MEMS mirrors could help to overcome such limitations.
>
> Thus, the very motivation that drove the development of 2-axis MEMS mirrors in the first instance, is the motivation to use 2-axis MEMS mirrors in applications where 1-axis mirrors were previously used. Some prior art references cited above disclose 1-axis MEMS mirrors, others disclose 2-axis MEMS mirrors, while others disclose both 1 and 2-axis MEMS mirrors. A person of ordinary skill in the art would have been motivated to combine the references disclosing 1-axis mirrors with those disclosing 2-axis mirrors to enhance the systems disclosed in the 1-axis mirror references to include a 2-axis mirror. Both the 1 and 2-axis mirror references disclose mirrors which are rotatable to direct a wavelength of light (or wavelength channel) to a specific location; for example, to an output port in order to perform a switching function in an optical network element.
>
> It would have been obvious to someone skilled in the art to replace a disclosed 1-axis MEMS mirror with a 2-axis MEMS mirror from another reference as a matter of common sense and routine innovation and would be merely the application of known elements

to achieve predictable results, with a reasonable expectation of success.

For example, at the time of the invention of the Patents-in-Suit, it was known in the art that it was advantageous in optical switching systems to equalize the output power of all wavelength channels. *E.g.*, U.S. Patent Application No. 601234,683, p. 11. It was also known in the art that the optical throughput of each wavelength channel could be controlled by using a MEMS mirror (or mirror array) that could be rotated about two axes. *Id.* at 6. For example, rotation about a first axis could be used to perform switching functions, such as optical cross-connections (directing a wavelength channel to a specific output port), while rotation about a second axis could be used for power control. *Id.* It was also known in the art that both the switching functions and power control could be accomplished using 1-axis MEMS mirrors, but that compared to 2-axis MEMS mirror systems, 1-axis MEMS mirror systems suffer from increased potential for crosstalk between channels. *Id.* at 11. Accordingly, at the time of the alleged invention, it would have been obvious to those skilled in the art to utilize 2-axis MEMS mirrors in optical switching systems disclosing only 1-axis MEMS mirrors, in order to enable power control while minimizing cross talk. *Id.* at 10 ("2-axis MEMS arrays may be used to control the output of prior art switches. For example, they may be used to add output power control capability to the prior art designs disclosed in *Tomlinson* and *Solgaard*.").

As another example, at the time of the invention of the Patents-in-Suit, a typical requirement of optical cross-connects was that any input be capable of being connected to any output. U.S. Patent No. 6,798,992, col. 2, ll. 55-56. Output ports can be configured in 1 or 2-dimensional arrays. In at least some systems, 2-dimensional ("2-D") arrays are preferable. *Id.* at col. 3, ll. 17-22. When output ports are configured in a 2-dimensional array, it would be desirable to use an array of 2-axis MEMS mirrors so that each wavelength channel reflected by a 2-axis MEMS mirror could be directed to any of the output ports in the 2-dimensional array. Accordingly, at the time of the invention, it would have been obvious to those skilled in the art to utilize 2-axis MEMS mirrors in optical switching systems in order to utilize output ports configured in a preferable 2-dimensional array

Those skilled in the art would also be motivated to substitute 1-axis MEMS mirrors with 2-axis MEMS mirrors because of increased port density through 2-D arrays, reduced crosstalk, and ability to reduce device size through 2-D arrays. In addition to the common sense of the person skilled in the art, such motivations for

> the combination are found in the prior art, such as: U.S. Patent No, 6,798,941, col. 16, ll. 55-59, col. 18, ll. 18-25; and U.S. Patent No. 6,253,001, col. 2, ll. 1-16.
>
> Moreover, as there are only limited available options to try —1 or 2 axis mirrors —the substitution of 1-axis mirrors with 2-axis mirrors would have been obvious to try. Given these reasons, it would have been obvious to use 2-axis deflecting elements….

Defendants Coriant (USA), Inc.'s and Columbus Networks USA, Inc.'s Preliminary Invalidity Contentions, *Capella Photonics, Inc. v. Tellabs, Inc.*, No. 14-CIV-60350 (S.D. Fla. June 16, 2014) (Dkt. 62) at 21–24.

b. Continuous (Analog) Mirror Control

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to have continuous analog mirror control for at least the following reasons stated in previously served invalidity contentions:

> Rotating MEMS mirrors by continuous analog control in fiber-optic systems was well known by 1999. For example, an application to Smith discloses "the optical throughput of each wavelength channel may be controlled by using a mirror array with elements that can be rotated in an analog fashion about two orthogonal axes" (U.S. Patent App. 60/234,683, p. 6); an application to Heanue described "... a optical switching module 100 that were first made in March 1999, using 2D mirror surfaces 116 whose orientations were controlled by analog dual axis servo controllers" (U.S. Patent App. 2003/0223726, ¶ 48); a patent to Bishop disclosed "[a] typical requirement of optical crossconnects is that any input be capable of being connected to any output.... Each mirror „.is capable of operatively rotating or tilting about orthogonal X-Y axes, with the tilt angle being selectively determined by the amount of voltage applied to the control electrodes" (U.S. Patent No. 6,798,992, col. 2, ll. 55-65); a patent to Riza disclosed that "attenuation control in these modules is implemented in an analog fashion by carefully moving a micromirror per beam (or wavelength) through a continuous range of positions" (U.S. Patent No. 6,222,954, col. 2, ll. 23-26)
>
> It would have been obvious to someone skilled in the art to incorporate the continuous mirror control features of the prior art with other optical switching devices as a matter of common sense

> and routine innovation. Also, such a combination would be merely the application of known elements to achieve predictable results, with a reasonable expectation of success.
>
> Analog control allows for more flexibility in the rotation of a MEMS mirror, along withgreater precision, providing improved power/attenuation control and switching capability. (See, e.g., U.S. Patent No. 6,798,992, col. 2, ll. 55-65; U.S. Patent No. 6,222,954, col, 2, ll. 23-26). A person skilled in the art would have been motivated to incorporate the continuous mirror control features of the prior art with other optical switching devices in order to have greater precision and rotation flexibility in a MEMS mirror (for example, to direct a wavelength channel to any output port as suggested by, e.g., U,S. Patent No. 6,798,992, col. 2, ll. 55-56). Additionally, a person skilled in the art would be motivated to use the known continuous mirror control features of the prior art to improve similar devices, such as the devices disclosed in U.S. Patent No. 6,507,421, col. 3, l. 10-11, and U.S. Patent No. 6,253,001, col. 1, l. 65 to col. 2, l. 13.
>
> Moreover, the substitution of discretely controlled mirrors with continuously controlled mirrors would have been obvious to try. (See, e.g., U.S. Patent No. 5,661,591,col. 2, ll. 7-9, col. 3, ll. 41-57).
>
> The prior art also suggests such a combination. For example, a patent to Lin discloses that a discretely movable mirror may optionally be continuously controlled for enhanced functionality. (U.S. Patent No, 5,661,591, col. 2, ll. 7-9, col. 3, 11, 41-57; see also, U.S. Patent App. 60/234,683, p. 6, Fig. 11).

Id. at 24–26.

c. Power Control By Mirror Misalignment

A person of ordinary skill in the art would have been motivated to combine or modify the prior art for power control by mirror misalignment for at least the following reasons stated in previously served invalidity contentions:

> To the extent that any of the prior art references do not explicitly or inherently disclose misalignment of MEMs mirrors for power control and attenuation, a person of ordinary skill in the art would have been motivated to add that to any of the prior art references that disclose MEMs mirrors, for the purpose of controlling signal power. The use of two-axis tiltable MEMS mirrors in fiber-optic

components for power control and attenuation was already well known by 1999. See, e.g., U.S. Patent No. 6,798,941 ("Smith") at 16:34-51,16:55-58, 17:53-18:25, Fig. 9; U.S. Patent No. 6,961,506 ("Neukermans") at Fig. 3a, 5:15-19,5:53-64; Bouevitch at 1:18-25; 1:50-61; 7:34-37; U.S. Patent No. 6,519,075 ("Carr") at 13:47-62; 14:22-29; U.S. Patent No. 6,625,340 ("Sparks") at 2:20-25; 5:1-11; Fig. 2b.

The benefits of using tiltable MEMS mirrors for power control and attenuation were also clear. For example, with such power control, it was possible for ROADMs and cross-connects to achieve power equalization in which the power levels of different wavelength channels are adjusted to conform to a standardized non-flat spectrum for downstream devices. See, e.g., Smith at 10:10-13. Smith further explains that such power equalization is desired in order to, for example, satisfy the dynamic range restrictions of downstream receivers, or satisfy the amplifier input limits of downstream receivers. Smith at 10:47-55. Further, Neukermans explains that it is "highly desirable" to control power of different spectral channels at a common, predetermined power value because otherwise, if they are "multiplexed together without controlling their respective strengths, wavelengths having different strength may increase differently during subsequent optical amplification." Neukermans at 2:60-3:7. In addition, the use of 2-axis tiltable mirrors for signal misalignment was preferred as the non-switching axis can be used to control power and minimize cross talk. Smith at 18:15-21. Further, many references, such as Smith and U.S. Patent No. 6,798,992 ("Bishop") recognized the problem that optical switches are susceptible to "drift" due to environmental conditions, such as temperature changes, and manufacturing variations. Bishop at 3:54-58; see also Smith at 10:22-23; 17:53-18:11. By controlling power through the misalignment of MEMs mirrors, one of ordinary skill in the art could solve such "drift" problems.

Given these reasons, it would have been obvious to a person of ordinary skill in the- art to have combined the known method of misaligning MEMs mirrors to control power …, with other references …, to achieve predictable results and benefits with a reasonable expectation of success. For example, many [] references taught the use of tilting 2D mirrors in NxN cross-connects to control power. Some of these references include U.S. Patent Publication Nos. 2003/0223726 and 2002/0092963, and the following U.S. Patents {collectively, the "Known NxN Cross-Connects")

6,798,941;

6,507,421;
6,798,992;
6,480,645;
6,442,307;
6,519,075;
6,567,574;
6,989,921;
6,792,174;
6,668,108;
6,697,547;
6,253,001;
6,778,739

It would have been obvious to someone skilled in the art to incorporate the 2D mirror tilting and power control functionality of the Known NxN Cross-Connects with another NxN fiber optic component …, such as Patent No. 6,097,859 ("Solgaard"), Solgaard discloses an NxN wavelength selective cross-connect with multiple input ports and output ports. Solgaard also teaches that an input signal is separated by a grating device and each wavelength is impinged upon a mirror in a tiltable micromirror array where each wavelength channel can be routed to any output port. Solgaard further discloses a spectral monitor that reports signal power to the control unit. One of ordinary skill would have been motivated to modify Solgaard's NxN cross-connect and its tiltable mirrors in view of the Known NxN Cross-Connects to achieve power control by mirror mis-alignment for several reasons. First, both the Solgaard crossconnect and any one of the Known NxN Cross-Connects are conceptually similar and compatible in that they both disclose a cross connect with multiple input ports and multiple output ports. Moreover, the control unit disclosed in Solgaard receives reported power, so it would have been obvious for a person of ordinary skill in the art to modify it in order to also control or attenuate power by deliberate misalignment as disclosed in the Known NxN Cross-Connects to achieve the associated benefits.

As another example, one of ordinary skill in the art would have found it obvious to incorporate the 2D mirror tilting and power control functionality of the Known NxN CrossConnects with ROADM references such as Bouevitch. Bouevitch already contemplates power control by adjusting the angle of deflection, Bouevitch at 7:34-37. References such as Smith discuss the benefits of using 2D tiltable mirrors for power control, such as minimizing cross talk, Thus, one of ordinary skill would have been motivated to incorporate 2D tiltable mirrors, such as those from

> Smith, into ROADM references, such as Bouevitch, to implement power control.

Id. at 26–29.

d. Control Unit

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include a control unit for at least the following reasons stated in previously served invalidity contentions:

> To the extent that any of the prior art references do not explicitly or inherently disclose a control unit for controlling beam-deflecting elements such as micromirrors, a person of ordinary skill in the art would have been motivated to add a control unit to any of the prior art references that disclose one or more beam-deflecting elements, for the purpose of controlling those beam-deflecting elements. Without such a control unit, the beam-deflecting elements would not be adjustable, and thus most, if not all, devices incorporating the beam-deflecting elements would fail to function properly. For instance, without a control unit to control the beam-deflecting elements in an optical switch device such as a ROADM or optical cross-connect, the optical switching device would be incapable of changing the switch configuration between the input port(s) and the output port(s). Thus, including a control unit is not only desirable, it is essential to the operation of such devices.
>
> It would also have been obvious to a person of ordinary skill in the art to have combined prior art elements, such as known control units, according to known methods to yield predictable results with a reasonable expectation of success. In fact, it was already known, at the time of the invention, to control micromirror arrays and other beam-deflecting elements to achieve reconfigurable optical switching and dynamic optical power control. Indeed, the Patents-in-Suit themselves acknowledge that such functionality was well-known and easy for one of ordinary skill to implement at the time of the invention.
>
>> The electronic circuitry and the associated signal processing algorithm/software for such processing unit in a servo-control system are known in the art. A skilled artisan will know how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application.

('368 patent, col. 12, ll. 9-15; '678 patent, col. 12, ll. 9-15). Consistent with the inventors' admissions, the prior-art references … teach control units comprising power monitors for monitoring of power levels of optical channels and processing units that, based on the power levels, controlled switching devices of the optical channels for various reasons. Such reasons include maximizing optical coupling/power transfer, equalizing optical power across multiple spectral channels, and controlling power of an optical channel to specific levels….

As discussed herein in section II(c)(iii)(a), the use of tiltable MEMS mirrors in fiber-optic components for power control and attenuation was well known. It was also well known prior to the effective filing date of the Patents-in-Suit to use a control unit to control those mirrors (e.g., U.S. Patent No. 6,097,859 ("Solgaard")) and as a means for feedback control of the MEMS mirrors to control power through mirror misalignment.

For example, U.S. Patent No. 6,697,547 to Walter et al, discloses a switch matrix 30 (fig. 2) used in a dense wave division multiplexing (DWDM) optical network (col. 4 lines 45-52), in which a control unit having a spectral monitor 136 measures the optical power (fig. 10 step 1003) of each spectral output channel signal (fig. 4(a), 4(b), 5) Rom the switch matrix 30, and selectively positions channel reflecting elements in one or two axes based on the power measurements (Fig. 10 step 1015,Fig. 11, col. 11 lines 28-65).

As another example, U.S. Pat. Pub No. 2002/0092963 to Domash et al. discloses a control unit for steering beams with a MEMS mirror between optical ports (see paras. 0035-0043, 0047-0058)

As a further example, G. J. Su et al., MEMS 2D Scanning Mirror for Dynamic Alignment in Optical Interconnect, discloses controlling movement of a two-axis MEMS mirror to correct misalignment (i.e., coupling of an optical beam power between two ports) in a free space optical interconnect (see pp. 180-182) ("G.J.Su").

As yet another example, U.S. Patent No. 6,798,941 to Smith, et al. ("Smith") discloses a control unit that adjusts the tilt positions of micromirrors in a MEMS array. (Smith, Fig. 8 controller 158, Figs. 9 and 11-13controller 220, col. 9, ll. 20-25, col. 13, ll. 21-24, col. 18, ll. 42-53). The control units 158 and 220 control the micromirrors not only to direct beams to selected output ports, but also to control the power coupled into the output ports by offsetting the beams from the output ports in accordance with

> feedback from monitored optical power. (Smith, col. 9, l. 29 to col. 10, l. 113, col. 13, l. 51 to col. 14, l. 15). It would have been obvious to a person of ordinary skill in the art to have combined the disclosed control units of Smith with any of the MEMS arrays or other beam-deflecting elements disclosed in the prior art references, in the same manner as Smith and to yield the same known result as Smith —to allow for tilt control of the MEMS arrays or other beam-deflecting elements.
>
> Still further examples are U.S. Publication No. 2002/0081070 to Tew (Figs. 4, 6, and 8 controller 328, and Fig. 9 controller 902), U.S. Publication No. 2003/0223726 to Heanue (¶ 48, describing 2D mirror surfaces 116 whose orientations are controlled by analog dual axis servo controllers), and U.S. Patent No; 6,519,075 to Carr, et al. (Fig. 13, feedback system 139)…. For example, combining such references would have been nothing more than using known techniques of mirror control, spectral monitoring, feedback, and control processing in optical interconnects to provide a control unit…. For example, it would have been obvious to combine each of the optical interconnects disclosed …with …Walter, Domash, and G. J. Su, to utilize their control units to improve the performance of the systems by maximizing optical signal power coupling, equalizing spectral channels, correcting misalignment in optical interconnects, or even just to make the controllable mirrors functional. As a second reason to combine the references, the components used …, i.e., MEMS mirrors, optical ports, lens, and servo control of the mirrors for performing the functions of mirror control are the same or analogous to the components … for channel switching functions. It would have been obvious for a person of ordinary skill in the art to try to use these common components for both the functions of optical channel switching and for power control, as there would have been a reasonable expectation of success and a common sense advantage in reducing cost and size of the system by reducing the number of components needed to perform both functions.

Id. at 29–33.

e. Servo Control Assembly

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include a servo-control assembly for at least the following reasons stated in previously served invalidity contentions:

To the extent that any of the prior art references do not explicitly or inherently disclose such a servo-control assembly, a person of ordinary skill in the art would have been motivated to add a servo assembly to any of the prior art references that disclose one or more beam-deflecting elements, for the purpose of using feedback power measurements to control the beam-deflecting elements. It is well-recognized in the prior art, such as discussed below, to provide optical feedback control of micromirrors and other beam-deflecting elements in an optical switching device such as a ROADM or optical cross-connect.

It would also have been obvious to a person of ordinary skill in the art to have combined prior art elements, such as known control units, according to known methods to yield predictable results with a reasonable expectation of success. In fact, it was already known, at the time of the invention, to control micromirror arrays and other beam-deflecting elements using spectral power feedback. In fact, the Patents-in-Suit acknowledge that such functionality was well-known and easy for one of ordinary skill to implement at the time of the invention:

> The electronic circuitry and the associated signal processing algorithm/software for such processing unit in a servo-control system are known in the art. A skilled artisan will know how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application.

('368 patent, col. 12, 11, 9-15; '678 patent, col. 12, ll. 9-15). Consistent with the inventors' admissions, the prior-art references … teach a servo control assembly for the monitoring of power levels of optical channels and, based on the power levels, controlling switching devices of the optical channels for various reasons. Such reasons include maximizing optical coupling/power transfer, equalizing optical power across multiple spectral channels, and controlling power of an optical channel to specific levels….

As discussed herein in section II(c)(iii)(a), the use of tiltable MEMS mirrors in fiber-optic components for power control and attenuation was well known. It was also well known prior to the effective filing date of the Patents-in-Suit to use power monitoring of spectral channels to monitor the quality of optical signals (e.g., U,S. Patent No. 6,097,859 ("Solgaard")) and as a means for feedback control of the MEMS mirrors to control power through ese Contentions, whe

For example, U.S. Patent No. 6,697,547 to Walter et al. discloses a switch matrix 30 (fig. 2) used in a DWDM optical network (col. 4 lines 45-52), in which a servo control assembly having spectral monitor 136 measures the optical power (fig. 10 step 1003) of each spectral output channel signal (fig. 4(a), 4(b), 5) from the switch matrix 30, and selectively maximizes and/or attenuates individual optical channels based on the power measurements (fig. 10 step 1015,fig. 11)by positioning channel reflecting elements in one or two axes (col. 11 lines 28-65).

As another example, Domash discloses the use of a servo control assembly with sensors (figs. 5, 6) that detects two-axis misalignment using a thin-film sensor of an optical beam steered with a MEMS mirror between optical ports, and a feedback system responsive to the sensors for two-axis fine steering of the MEMS mirror to maximize power transfer (see paras. 0035-0043, 0047-0058).

As a further example, G. J, Su et al. discloses the use of a two-axis MEMS mirror and dynamic tracking to correct misalignment (i,e., coupling of an optical beam power between two ports) in a free space optical interconnect (see pp. 180-182).

As yet another example, Smith discloses a servo control assembly that receives output of an optical power monitor (OPM) and readjusts the tilt positions of micromirrors in a MEMS array in accordance with the output. (Smith, Fig. 8 controller 158 in communication with OPM 156, Figs. 9 and 11-13controller 220 in communication with OPM 218, col. 9, ll. 20-28, col. 13, ll. 21-24, col. 18, l. 42 to col. 19, l. 7). The controllers 158 and 220 of the servo control assembly control the micromirrors not only to direct beams to selected output ports, but also to control the power coupled into the output ports by offsetting the beams from the output ports in response to feedback from the OPMs 156 and 218. (Smith, col. 9, l. 29 to col. 10, l. 113,col. 13, l. 51 to col. 14, l. 15).

Still further examples of a servo control assembly are disclosed in U.S. Publication No. 2002/0081070 to Tew (Figs. 4, 6, and 8, controller 328 in communication with detector 324, and Fig. 9, controller 902 in communication with detector 324), U.S. Publication No. 2003/0223726 to Heanue ('I 48, describing 2D mirror surfaces 116 whose orientations are controlled by analog dual axis servo controllers), and U.S, Patent No; 6,519,075 to Carr, et al. (Figs. 12 and 13, feedback system 139).

Each of these above specific examples, the admitted prior art noted above, and []other references…teach a servo control assembly for

> performing the monitoring, feedback and processing/control features of the claims noted above in the same or analogous optical interconnect and optical switching architectures … in ROADMS and Optical cross-connects….
>
> For one, combining such references would have been nothing more than using known techniques of spectral monitoring, feedback, and control processing in optical interconnects to provide a servo-control assembly … to similar optical interconnects … in the same ways and for the same purposes …. For example, it would have been obvious to combine each of optical interconnects disclosed in Smith, Carr, Tew … with any of …Walter, Domash, and G. J. Su, to improve the performance of the systems by maximizing optical signal power coupling, equalizing spectral channels, and correcting misalignment in optical interconnects.
>
> As a second reason to combine the references, the components used…, i.e., MEMS mirrors, optical ports, lens, and servo control of the mirrors for performing the functions of spectral monitoring and feedback servo control of the mirrors are the same or analogous to the components … for channel switching functions. It would have been obvious for a person of ordinary skill in the art to try to use these common components for both the functions of optical channel switching and for power control in a feedback loop, as there would have been a reasonable expectation of success and a common sense advantage in reducing cost and size of the system by reducing the number of components needed to perform both functions.

Id. at 33–37.

f. Spectral Monitor

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include a spectral monitor for at least the following reasons stated in previously served invalidity contentions:

> The use of spectral monitoring and processing for feedback control was not new as of the effective filing date of the Patents-in-suit. Indeed, the inventors admit:
>
> > The processing unit ...typically includes electrical circuits and signal processing programs for processing the power measurements received from the spectral monitor 460 and generating appropriate control signals to be applied to the

> channel micromirrors 430 ...so to maintain the coupling efficiencies of the spectral channels into the output ports at desired values, The electronic circuitry and the associated signal processing algorithm/software for such processing unit in a servo-control system are known in the art. A skilled artisan will know how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application.

'368 patent, 12:1-15 (emphasis added). Consistent with the inventors' admissions, the prior-art references identified … teach the monitoring of power levels of optical channels and, based on the power levels, controlling switching devices of the optical channels for various reasons. Such reasons include maximizing optical coupling/power transfer, equalizing optical power across multiple spectral channels, and controlling power of an optical channel to specific levels.

As discussed herein in section II(c)(iii)(a), the use of tiltable MEMS mirrors in fiber-optic components for power control and attenuation was well known. It was also well known prior to the effective filing date of the Patents-in-Suit to use power monitoring of spectral channels to monitor the quality of optical signals (e.g., U.S. Patent No. 6,097,859 ("Solgaard")) and as a means for feedback control of the MEMS mirrors to control power through mirror misalignment.

For example, U.S. Patent No. 6,697,547 to Walter et al. discloses a switch matrix 30 (fig. 2) used in a DWDM optical network (col. 4 lines 45-52), in which a spectral monitor 136 measures the optical power (fig. 10 step 1003) of each spectral output channel signal (fig. 4(a), 4(b), 5) from the switch matrix 30, and selectively maximizes and/or attenuates individual optical channels based on the power measurements (fig. 10 step 1015, fig. 11) by positioning channel reflecting elements in one or two axes (col. 11 lines 28-65).

As another example, Domash discloses the use of sensors (figs. 5, 6) that detects two-axis misalignment using a thin-film sensor of an optical beam steered with a MEMS mirror between optical ports, and a feedback system responsive to the sensors for two-axis fine steering of the MEMS mirror to maximize power transfer (see paras. 0035-0043, 0047-0058).

As a further example, G. J. Su et al. discloses the use of a two-axis MEMS mirror and dynamic tracking to correct misalignment (*i.e.*,

coupling of an optical beam power between two ports) in a free space optical interconnect (see pp. 180-182).

As yet another example, Smith discloses a controller that receives output of an optical power monitor (OPM) and readjusts the tilt positions of micromirrors in a MEMS array in accordance with the output. (Smith, Fig. 8 controller 158 in communication with OPM 156, Figs. 9 and 11-13controller 220 in communication with OPM 218, col. 9, ll. 20-28, col. 13, ll. 21-24, col. 18, l. 42 to col. 19, l. 7). The controllers 158 and 220 control the micromirrors not only to direct beams to selected output ports, but also to control the power coupled into the output ports by offsetting the beams from the output ports in response to feedback from the OPMs 156 and 218. (Smith, col. 9, l. 29 to col. 10, l. 113, col. 13, l. 5 l to col. 14, l. 15).

Still furthers examples are U.S. Publication No. 2002/0081070 to Tew (Figs. 4, 6, and 8, controller 328 in communication with detector 324, and Fig. 9, controller 902 in communication with detector 324), and U.S. Patent No; 6,519,075 to Carr, et al, (Figs. 12 and 13, feedback system 139)

Each of these above specific examples, the admitted poor art noted above, and other references ... teach performing the monitoring, feedback and processing/control features of the claims noted above in the same or analogous optical interconnect and optical switching architectures … in ROADMS and Optical cross-connects….

For example, combining such references would have been nothing more than using known techniques of spectral monitoring, feedback, and control processing in optical interconnects … similar optical interconnects … in the same ways and for the same purposes …. For example, it would have been obvious to combine each of optical interconnects disclosed in Smith, Carr, Tew, … with … Walter, Domash, G. J. Su, to improve the performance of the systems by maximizing optical signal power coupling, equalizing spectral channels, and correcting misalignment in optical interconnects.

As a second reason to combine the references, the components used, *i.e.*, MEMS mirrors, optical ports, lens, servo control of the mirrors for performing the functions of spectral monitoring and feedback servo control of the mirrors are the same or analogous to the components in the references … for channel switching functions. It would have been obvious for a person of ordinary skill in the art to try to use these common components for both the functions of optical channel switching and for power control in a

> feedback loop, as there would have been a reasonable expectation of success and a common sense advantage in reducing cost and size of the system by reducing the number of components needed to perform both functions.

Id. at 37–41.

g. Predetermined Power Values

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include predetermined power levels for at least the following reasons stated in previously served invalidity contentions:

> Maintaining power levels of the spectral channels coupled into the output ports at a predetermined value was well-known in the prior art by 1996. For example, U.S. Patent No. 5,745,271 ("Ford") describes the MARS modulator used for power equalization. Moreover, U.S. Patent No. 6,798,941 ("Smith") discloses that "all wavelength channels on [the] output fiber[s] should have the same intensity so that optical receivers and other components located downstream will detect wavelength channels of equal intensity." Smith at 9;59-63. As another example, U.S. Patent No. 6,961,,506("Neukermans") discloses that "it [is] highly desirable that all wavelengths being multiplexed into a single optical fiber have approximately the same power." Neukermans at 2;60-3:7.
>
> It would have been obvious for someone skilled in the art to maintain power levels of the spectral channels at a predetermined value in a cross-connect or ROADM because of many wellknown benefits conferred. As Smith explains, such power equalization at a predetermined value is desired in order to, for example, satisfy the dynamic range restrictions of downstream receivers and to satisfy the amplifier input limits of downstream receivers. Smith at 10:47-55. And Neukermans explains that it is "highly desirable" to maintain power of different spectral channels at a common, predetermined power value because otherwise, if they are "multiplexed together without controlling their respective strengths, wavelengths having different strength may increase differently during subsequent optical amplification." Neukermans at para. 0011. Further, many references, such as Smith and U.S. Patent No. 6,798,992 ("Bishop") recognized the problem that optical switches are susceptible to "drift" due to environmental conditions, such as temperature changes, and manufacturing variations. Bishop at 3:54-58; *see also* Smith at 10:22-23; 17:53-18:11.And it would have been obvious for a person of ordinary

> skill in the art to use the ability to maintain power levels to solve such "drift" problems. Finally, during the operation of ROADM and crossconnect systems, wavelength channels are constantly being added and removed, which in turn affects power levels of the wavelength channels in transit. U.S. Patent No. 6,442,307 ("Carr") and U.S. Patent No. 5,745,271 ("Ford") both explain that maintaining power levels at a predetermined value solves this problem. Carr at 11:34-52; Ford at 1:58-2:10.
>
> Given these reasons, one of ordinary skill would have found it obvious to include the capability of maintaining spectral channel power levels at a predetermined value when designing ROADMs and crossconnects.

Id. at 41–42.

h. *Control Unit Controlling Mirrors to Drop a Channel*

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include a control unit controlling mirrors to drop a channel for at least the following reasons stated in previously served invalidity contentions:

> OADMs that implement add/drop channels were not new at the time of the alleged invention and addressed a recognized need in the industry, as conceded by the inventors. For example, the background section of the Patents-in-Suit refers to U.S. Patent Nos. 5,974,207, 6,205,269, 6,204, 946, and 5,9[60],133 as disclosing OADMs that utilize add and drop ports (e.g., '368 patent, col. 1, l. 59 to col. 3, l. 19). There are many other prior-art references that disclose OADMs, and/or optical cross-connects (OXCs) or other switching matrices usable in OADMs, having or otherwise supporting multiple input ports such as one or more add ports and/or multiple output ports such as one or more drop ports….
>
> Some examples of … prior art disclosing OADMs with the capability to add or drop spectral channels, include U.S. Patent No. 6,798,941 ("Smith") at figs. 5-6, col. 10 lines 4-12; U.S. Patent No. 6,097,859 ("Solgaard") at figs. 1-8; and U.S. Patent No. 6,498,872 ("Bouevitch") at fig. 1.
>
> An example in the … prior art disclosing an OXC used in systems for adding and dropping spectral channels is U.S. Patent No. 6,697,547 to Walter et al., which discloses an OXC 30 (fig. 2) used in a DWDM optical network (col, 4 lines 45-52), that receives spectral channels at any of a plurality of input ports and switches

> the spectral channels to any of a plurality of output ports (see fig. 4(a), 4(b), 5, 8, col. 8 lines 52-55). Other examples of prior art references including OXCs used in WDM systems for add and drop functions include: U.S. Patent No; 6,519,075 ("Carr") at col. 11 lines 11-52; U.S. Patent No. 6,798,941 ("Smith") at fig. 3 (prior art), 3:22-50; and Paul M. Hagelin et al., Scalable Optical Cross-Connect Switch Using Micromachined Mirrors, IEEE Photonics Technology Letters, Vol. 12, No. 7, 2000.
>
> It would have been obvious to a person of ordinary skill in the art to have combined prior art elements, such as these and other known OXCs, OADMs and other optical switching devices, according to known methods and/or common sense to yield predictable results with a reasonable expectation of success. For example, it would have been obvious to have utilized any of the OXC prior-art references … that support add and/or drop ports in any of the OADM or other optical switching prior-art references … to achieve an OADM that controls a set of mirrors to add an input light beam from an add port and to direct one or more optical channels to a drop port. Combining such references would have involved nothing more than using known techniques of fiber optic coupling and mirror control in optical switching devices. And, because many of these prior-art references … utilize a programmable control unit and/or servocontrol assembly, the control units and/or servo-control assemblies in those prior-art references may be easily reprogrammed in known ways to direct the light beams accordingly. As admitted in the Patents-in-Suit, a skilled artisan would have known how to implement an appropriate processing unit to provide a servo-control assembly in a wavelength-separating-routing apparatus that controls the mirrors for a given application (e.g., '368 patent, col. 12, ll. 11-15). Moreover, combining the prior-art references in this way would have provided an even simpler, more effective, and more economical approach to providing add/drop functionality as compared with the systems allegedly suffering from these problems as described in the background section of the Patents-in-Suit.

Id. at 42–44.

i. Control Unit Controlling Mirrors to Add a Channel

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include a control unit controlling mirrors to add a channel for at least the following reasons stated in previously served invalidity contentions:

OADMs that implement add/drop channels were not new at the time of the alleged invention and addressed a recognized need in the industry, as conceded by the inventors. For example, the background section of the Patents-in-Suit refers to U.S. Patent Nos. 5,974,207, 6,205,269, 6,204, 946, and 5,9[60],133 as disclosing OADMs that utilize add and drop ports (e.g., '368 patent, col. 1, 1. 59 to col. 3, l. 19). There are many other prior-art references that disclose OADMs, and/or optical cross-connects (OXCs) or other switching matrices usable in OADMs, having or otherwise supporting multiple input ports such as one or more add ports and/or multiple output ports such as one or more drop ports….

Some examples of … prior art disclosing OADMs with the capability to add or drop spectral channels, include U.S. Patent No. 6,798,941 ("Smith") at figs, 5-6, col. 10 lines 4-12; U.S. Patent No. 6,097,859 ("Solgaard") at figs. 1-8; and U.S. Patent No. 6,498,872 ("Bouevitch") at fig. l.

An example in the … prior art disclosing an OXC used in systems for adding and dropping spectral channels is U.S. Patent No. 6,697,547 to Walter et al., which discloses an OXC 30 (fig. 2) used in a DWDM optical network (col. 4 lines 45-52), that receives spectral channels at any of a plurality of input ports and switches the spectral channels to any of a plurality of output ports (see fig. 4{a),4(b), 5, 8, col. 8 lines 52-55). Other examples of prior art references including OXCs used in WDM systems for add and drop functions include: U.S. Patent No; 6,519,075 ("Carr") at col. 11 lines 11-52; U.S, Patent No. 6,798,941 ("Smith") at fig. 3 (prior art), 3:22-50; and Paul M. Hagelin et al., Scalable Optical Cross-Connect Switch Using Micromachined Mirrors, IEEE Photonics Technology Letters, Vol. 12, No. 7, 2000.

It would have been obvious to a person of ordinary skill in the art to have combined prior art elements, such as these and other known OXCs, OADMs and other optical switching devices, according to known methods and/or common sense to yield predictable results with a reasonable expectation of success. For example, it would have been obvious to have utilized any of the OXC prior-art references … that support add and/or drop ports in any of the OADM or other optical switching prior-art references … to achieve an OADM that controls a set of mirrors to add an input light beam from an add port and to direct one or more optical channels to a drop port. Combining such references would have involved nothing more than using known techniques of fiber optic coupling and mirror control in optical switching devices. And, because many of these prior-art references … utilize a programmable control unit and/or servo-control assembly, the

> control units and/or servo-control assemblies in those prior-art references may be easily reprogrammed in known ways to direct the light beams accordingly. As admitted in the Patents-in-Suit, a skilled artisan would have known how to implement an appropriate processing unit to provide a servo-control assembly in a wavelength-separating-routing apparatus that controls the mirrors for a given application (e.g., '368 patent, col. 12, ll. 11-15). Moreover, combining the prior-art references in this way would have provided an even simpler, more effective, and more economical approach to providing add/drop functionality as compared with the systems allegedly suffering from these problems as described in the background section of the Patents-in-Suit.

Id. at 44–46.

j. *Use of a "Ruled Diffraction Grating"*

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include a ruled diffraction grating for at least the following reasons stated in previously served invalidity contentions:

> To the extent that any of the prior art references do not explicitly or inherently disclose wavelength separation, a person of ordinary skill in the art would have been motivated to add that to any of the prior art references …, for the purpose of wavelength selective routing. Wavelength separation in fiber-optic components for wavelength selective routing was well known by 1999. See, e.g., Bouevitch, Fig. 11, 1:31-50, 14:14-20, 48-55; U.S. Patent No. 6,263,127 at 3:8-41; US 2002/0081070, 0005-0006, 0033-0044; US 5,936,752, 1:55-60, 2:61-3:12,3:49-55;U.S. Patent No. 6,798,941; U.S. Patent No. 6,498,872; U.S. Patent No. 6,097,859 at 3:57-4:1;"Wavelength Add —Drop Switching Using Tilting Micromirrors," by Ford et al. For example, by 1999 and the early 2000s, many references taught the use of diffraction grating for the benefit of separating a multi-wavelength signal into individual wavelength channels so that each channel can be independently processed (e.g. attenuated) and routed. See, e.g., Solgaard '859 patent at 3:57-4:1;Bishop '752 patent at 2:61-3:12and 3:49-55; Tew at 0005-0006 and 0033-0044; U.S. Patent No. 6,263,127 ("Dragone") at 3:8-41. In view of this benefit, it would have been obvious for someone skilled in the art to incorporate a diffraction grating module into any of the references …, including the Known NxN Cross-Connects. For example, Dragone discloses two different wavelength separating devices —an array waveguide

> grating and a diffraction grating —that allow for the demultiplexing of signals to be processed by a 2D mirror array. One of ordinary skill would have been motivated to modify any Known NxN CrossConnects, e.g., U.S. Patent No. 6,442,307 ("Carr"), to include Dragone's wavelength selective routing capability. Carr's cross connect already used a similar 2D mirror array as the core component, so it would have been obvious to include Dragone's wavelength separating device into Carr's system to realize an apparatus with wavelength selective routing and add-drop functionality.

Id. at 46–47.

k. Using Reflective Membranes as Beam-deflecting Elements

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to use reflective membranes as beam-deflecting elements for at least the following reasons stated in previously served invalidity contentions:

> To the extent that any of the prior art references do not explicitly or inherently disclose the use of reflective membranes as beam-deflecting elements, it would have been obvious to use such membranes. Reflective membranes were well known at the time of the effective filing date of the Patents-in-Suit, and a person of ordinary skill in the art would have been motivated to use such membranes for beam-deflecting.
>
> Reflective membranes used for switching (e.g., beam deflection) were known to have "wide fabrication tolerance, high speed, wide optical spectrum, and low total packaged cost." (James A, Walker et al., Fabrication of a Mechanical Antireflection Switch for Fiber-to-the-Home Systems, 5 J. Microelectromechanical Sys. 45, 46 (1996) ("Walker").) Membrane switches also had relative advantages over other deflecting elements. In comparison to reflective membranes, "[b]y the very nature of their modulation mechanisms, the deformable light valve and variable Fabry-Perot device suffer from a narrow optical spectrum and high fabrication complexity, which leads to high fabrication cost." (*Id.*)
>
> There are multiple reasons that using membranes was obvious. First, using such membranes was a simple substitution of one known element for another to obtain predictable results. Second, even without an awareness of membranes as a substitute, it would have been obvious to a person of ordinary skill in the art to try reflective membranes as solutions for beam-deflecting. There were

> a relatively small number of alternative deflecting element solutions (such as MEMS micromirrors and comb-drive-actuated devices), and one of skill would have had a reasonable expectation for success in using reflective membranes.
>
> The Patents-in-Suit themselves allege that (1) membranes were known in the prior art; and (2) that that one of skill in the art would have considered membranes as an option to implement beam deflecting mirrors, and (3) would have had a reasonable expectation of success doing so. This is because the Patents-in-Suit explicitly suggest the use of membranes in the alleged invention. "The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam —deflecting means known in the art." ('368 patent, 4:22-25.)
>
> Using reflective membranes as beam-deflecting elements was not only known, their use was known within the same types of devices claimed in the Patents-in-Suit. As discussed below, membranes were known for use in optical switching applications within wavelength division multiplexing ("WDM") devices. For this reason, one of skill in the art would have a reasonable expectation of success using such membranes to implement the ROADM devices in the Patents-in-Suit. Membrane switches were so well known in 1996 there was an established acronym for them: "MARS" (mechanical antireflection switches). (Walker at 46.)
>
> For example, the Bouevitch patent (that Capella admitted invalidated the pre-reissue claims of the Patents-in-Suit) disclosed the use of micromechanical membranes to act as modulators (beam deflecting elements) in WDM applications. Bouevitch explained that these modulators "include a movable membrane suspended above a substrate, defining a gap there between." (U.S. Patent No. 5,936,752 (Bishop '752") at 3:29-34 (incorporated in Bouevitch at 1:49-50.))
>
> As another example, Joseph E. Ford and James A. Walker, Dynamic Spectral Power Equalization Using Micro-Opto-Mechanics, 10 IEEE Photonics Tech. Letters 1440, 1441 (1998), describes the use of MARS membrane switches to control power in WDM systems. This is the same application that Capella contended was a point of novelty in the Patents-in-Suit.

Id. at 47–49.

l. Dynamic and Continuous 2-Axis Control

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include dynamic and continuous 2-axis control for at least the following reasons stated in previously served invalidity contentions:

> Dynamically and continuously controlling 2-axis MEMS mirrors in fiber-optic systems was well known by 1999. For example, an application to Smith discloses "the optical throughput of each wavelength channel may be controlled by using a mirror array with elements that can be rotated in an analog fashion about two orthogonal axes" (U.S. Patent App. 60/234,683, p. 6); an application to Heanue described "...aoptical switching module 100 that were first made in March 1999, using 2D mirror surfaces 116 whose orientations were controlled by analog dual axis servo controllers" (U.S. Patent App. 2003/0223726, ¶ 48); a patent to Bishop disclosed "[a] typical requirement of optical crossconnects is that any input be capable of being connected to any output.... Each mirror ...is capable of operatively rotating or tilting about orthogonal X-Y axes, with the tilt angle being selectively determined by the amount of voltage applied to the control electrodes" (U.S. Patent No. 6,798,992, col. 2, ll. 55-65); a patent to Riza disclosed that "attenuation control in these modules is implemented in an analog fashion by carefully moving a micromirror per beam (or wavelength) through a continuous range of positions" (U.S. Patent No.6,222,954, col. 2, ll. 23-26). Dynamic control can be performed by a servo-control assembly (see '368 patent, col. 5, ll. 63-64; '678 patent, col. 5, ll. 63-64). Servos are well known in the art for dynamically controlling systems based on internal feedback, including for controlling mirrors in optical switching systems. (See, e.g., U.S. Patent App. 2003/0223726, ¶ 48).
>
> It would have been obvious to one of ordinary skill in the art to incorporate dynamic and continuous 2-axis mirror control features of the prior art with other optical switching devices as a matter of common sense and routine innovation. Also, such a combination would be merely the application of known elements to achieve predictable results, with a reasonable expectation of success.
>
> Analog control allows for more flexibility in the rotation of a MEMS mirror, along with greater precision, providing improved power/attenuation control and switching capability. (See, e.g., U.S. Patent No. 6,798,992, col. 2, ll. 55-65; U.S. Patent No. 6,222,954, col. 2, ll. 23-26). Additionally, dynamic control allows a MEMS

> mirror to be automatically adjusted based on system feedback to maintain desired power, coupling, and gain levels. A person skilled in the art would be motivated to incorporate the dynamic and continuous 2-axis mirror control features of the prior art with other optical switching devices in order to automatically maintain desired power, coupling and gain levels, and to have greater precision and rotation flexibility in a MEMS mirror (for example, to direct a wavelength channel to any output port as suggested by, e.g,, U.S. Patent No. 6,798,992, col, 2, ll. 55-56). Additionally, a person skilled in the art would be motivated to use the known dynamic and continuous 2-axis mirror control features of the prior art to improve similar devices, such as the devices disclosed in U.S. Patent No. 6,507,421, col. 3, l. 10-11,and U.S. Patent No. 6,253,001, col. 1, l. 65 to col. 2, 1. 13.
>
> Moreover, as there are only limited available options to try the substitution of discretely and manually controlled mirrors with dynamically and continuously controlled mirrors would have been obvious to try. (See, e.g., U.S. Patent No. 5,661,591,col. 2, ll. 7-9, col. 3, ll. 41-57).
>
> The prior art also expressly contemplates such a combination. For example, "it is well known that WDM systems must maintain a significant degree of uniformity of power levels across the WDM spectrum, so that dynamic range considerations at. receivers and amplifier, nonlinear effects, and cross talk impairments can be minimized, ...This equalization should be dynamic and under feedback control...." (U.S. Patent No. 6,798,941, col. 6, ll. 37-50; see also, id. at col. 2, ll. 23-31, col. 7, ll. 24-31; U.S. Patent App. 60/234,683, p. 6, Fig. 11; U.S. Patent No. 5,661,591,col. 2, ll. 7-9, col. 3, ll. 41-57). Thus, teachings of the prior art provide reasons to use dynamic and continuous 2-axis control.

Id. at 49–51.

m. Additional Motivations to Combine Presented during IPR Proceedings

Infinera identifies and incorporates into these Contentions the following additional motivations to combine that were presented during IPR proceedings involving the ’368 and ’678 Patents.

> . . . To the PHOSITA, Bouevitch and Smith were combinable for purposes of establishing obviousness under 35 U.S.C. § 103(a). (Id., ¶ 28-47.) Most of the *KSR* obviousness rationales support

combining these two references. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 415-421 (2007); MPEP § 2141.

First, the use of Smith's 2-axis mirrors in Bouevitch's system is a simple substitution of one known, closely-related element for another that obtains predictable results. The 1-axis mirrors of Bouevitch and the 2-axis mirrors of Smith were known to be interchangeable. (Ex. 1028 at ¶¶ 39-41.) Smith expressly acknowledges this interchangeability: "in comparison to the two-axis embodiment, single axis systems may be realized using simpler, single axis MEMS arrays but suffer from increased potential for crosstalk between channels." (Ex. 1005 at 11; Ex. 1004 at 18:17-18.) Smith also states that "both single and dual axis mirror arrays may be used in a variety of switching configurations, although the two-axis components are preferred." (Ex. 1005 at 11; Ex. 1004 at 16:55-58; Ex. 1007 at 4:17-19 (claiming a crossconnect with "an array of tiltable mirrors comprising a plurality of mirrors, each mirror being tiltable ***about at least one*** tilting axis") (emphasis added).)

Second, combining Bouevitch with Smith is nothing more than the use of known techniques to improve similar devices. PHOSITA could use the 2-axis mirrors of the Smith ROADM as a replacement for the 1-axis mirrors in the similar Bouevitch ROADM. (Ex. 1028 at ¶¶ 42-44.) Each reference discusses devices in the same field of fiber optic communications (Ex. 1003 at 1:18; Ex. 1004 at 1:10-15; Ex. 1005 at 1). Each reference is directed at the same application in that field—optical switching for multi-wavelength WDM communications. (Ex. 1003 at Abstract; Ex. 1004 at Title.) Each reference discloses the same type of optical switch—a COADM. And each COADM uses the same type of WSS for switching—a MEMS-based optical add/drop multiplexer. As a result, using the known 2-axis mirrors in the Bouevitch ROADM is nothing more than the use of known techniques to improve similar devices. (Ex. 1028 at ¶¶ 42-44.) And using 2-axis mirrors for power control instead of 1-axis mirrors would yield the same predictable result for power control if used in the MEMS-based switch of Bouevitch. (Ex. 1028 at ¶¶ 43-45.) Rotation about either 1 or 2 axes would result in controllable misalignment to alter power. (Ex. 1028 at ¶¶ 43-45.)

Third, it would be obvious to try Smith's 2-axis mirrors in Bouevitch because 2-axis mirrors were among a small number of identified, predictable solutions, and PHOSITA had a high expectation of success with either. (Ex. 1028 at ¶ 45.) There are only two options for tilting MEMS mirrors: 1-axis and 2-axis mirrors. (Ex. 1028 at ¶ 45) Because Smith already disclosed the

> use of 2-axis mirrors (which were available by the '368 patent's priority date), PHOSITA would have a high expectation of success to try 2-axis mirror control in Bouevitch, both for switching and power control. (Ex. 1028 at ¶ 45.) And the impact of tilting in 1 or 2 axes for the steering of a light beam is entirely predictable. (See id., '368 patent, 4:25-29 (2-axes allows 2-D steering); Ex. 1028 at ¶ 45.)
>
> Fourth, Smith and Bouevitch, as well as other contemporaneous prior art, provide explicit motivations to combine the references. For example, PHOSITA would be motivated to use the 2-axis mirrors of Smith with the system of Bouevitch to reduce crosstalk in attenuation. (Ex. 1004 at 18:17-18; Ex. 1028 at ¶¶ 46-47.) Crosstalk is reduced by performing beam misalignment in a different axis than the axis used for switching. (Id.; Ex. 1004 at 16:55-59, 18:18-25.) The PHOSITA would also be motivated to use the 2-axis mirrors of Smith with the Bouevitch COADM to increase port density. (Ex. 1028 at ¶¶ 47, 69.) Compact, two-dimensional arrays of fiber ports can be utilized when two-axis mirrors allow beams to be steered in two dimensions to those ports. (Ex. 1028 at ¶ 47; Ex. 1003 at 2:9-21; Ex. 1007 at 3:10-11; Ex. 1009 at 2:1-16.)
>
> Finally, the Patentee's admission during prosecution that claim 1 was invalid over Bouevitch "further in view of one or more of" Ma, Jin, and Wagener also confirms that one of skill in the art would have been motivated to combine Bouevitch with Petitioner's other references which are similar to Ma, Jin, and Wagener. (See Ex. 1002 at 81-82.) By admitting that claim 1 was ***invalid*** over Bouevitch "further in view of one or more of" Ma, Jin, and Wagener, the Patentee also admitted the ***combinability*** of such references. This admission is important because Smith and other references that Petitioner combines with Bouevitch here are directed at the identical technology area as Ma Jin, & Wagener—MEMS-based optical switches for WDM. (See Ex. 1023 at 1:6-11, Ex. 1024 at 1:11-20, 2:27-39, Ex. 1025 at 3:20-34, 5:32-43.) Thus, the references Petitioner relies on here are also combinable.

Cisco Sys., Inc. v. Capella Photonics, Inc., Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2014-01166, at *19–23 (PTAB July 15, 2014); *see also, e.g.*, *id.* at 23–60 (discussing motivations to combine while discussing obviousness); *Cisco Sys., Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Patent No. RE42,678, IPR2014-01276 (PTAB Aug. 12, 2014) (applying a similar analysis to the '678 Patent).

> Petitioner submits that no showing of specific motivations to combine the respective references in Grounds 2-6 (set forth below) is required, as the respective combinations would have no unexpected results, and at most would simply represent known alternatives to one of skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 127 S.Ct. 1727, 1739-40 (2007). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 1742. Nevertheless, specific motivations and reasons to combine the references are identified below.

Fujitsu Network Comm'ns, Inc. v. Capella Photonics, Inc., Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2014-01166, at *15–16 (PTAB July 15, 2014); *see also Fujitsu Network Comm'ns, Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,678, IPR2015-00727 (PTAB Feb. 12, 2015) (applying a similar analysis, including for the below-cited portions of the -01166 Petition for the '368 Patent).

> A PHOSITA would have been motivated to combine Bouevitch with Carr for a number of independent reasons. *See* Ex. 1016 ¶ 141. Fundamentally, the two references cover highly related subject matter. Each reference discusses devices in the same field of fiber optic communications. Ex. 1005 at 1:6–15; Ex. 1002 at 1:10–19. Each reference is directed at the same application in that field—optical switching for wavelength-division-multiplexed (WDM) communications. Each reference discloses an optical add/drop switch using a MEMS-based WSS for switching. As a result, using the known 2-axis mirrors from Carr in the Bouevitch COADM would have been nothing more than using known techniques to improve similar devices. Because of the similarity between the devices disclosed in each reference, a PHOSITA would expect that each of these well-known techniques could be applied to the devices of the other patent.
>
> A PHOSITA would find it natural and obvious to combine teachings of Carr with the disclosure of Bouevitch. Ex. 1016 ¶ 142, Drabik Decl. Namely, providing the MEMS mirrors of Bouevitch with two-axis tilt capability enables the spatial positioning of returning beams in both transverse directions at the face of microlens array 12. Thus, errors in system alignment arising, e.g., from imperfect assembly or temperature changes—well known problems in free space optical systems—could be better

compensated. Likewise, a PHOSITA would seize upon Carr's teachings of feedback control for improved stabilization of mirror position and out-coupled optical power.

For example, a PHOSITA would have been motivated to combine the two-axis movable MEMS mirrors of Carr in the COADM of Bouevitch based on the teachings of the references, common sense and knowledge generally available to a PHOSITA, as the proposed combination would merely be substituting known elements to yield predictable results. Bouevitch discloses a COADM where multiwavelength light is spatially dispersed into channels by a diffraction grating and each channel is reflected by a different mirror in an array of MEMS mirrors along a different path for adding and dropping optical signals. Ex. 1002 at 14:14–15:18, Fig. 11. Carr discloses a two-dimensional array of double-gimbaled (i.e., two axes) movable MEMS mirrors that can be tilted to "any desired orientation." Ex. 1005 at 3:44–48. As a result, using the known two-axis mirrors of Carr in the Bouevitch COADM is nothing more than substituting known elements to yield predictable results. Ex. 1016 ¶ 143, Drabik Decl.

Also, it would have been obvious to try Carr's two-axis mirrors in Bouevitch because two-axis mirrors were among a small number of identified, predictable solutions, and a PHOSITA had a high expectation of success with two-axis mirrors. Ex. 1016 ¶ 144. There are only two options for tilting MEMS mirrors: one-axis and two-axis mirrors. Because Carr already disclosed the use of two-axis mirrors (which were available by the '368 Patent's priority date), a PHOSITA would have a high expectation of success upon trying two-axis mirror control in Bouevitch. *Id.* The impact of tilting in one or two axes for the steering of a light beam was entirely predictable to a PHOSITA. *See* Exs. 1018, 1025.

Additionally, a PHOSITA would have been motivated to combine the continuously controllable mirrors of Carr with the COADM of Bouevitch. A PHOSITA would have been motivated to combine the teachings of these references at least for the following reasons: (1) continuously controlled mirrors were known to be an alternative to digital (discretely positioned) mirrors; (2) continuously controlled mirrors allow arbitrary positioning of mirrors and provide more precise control of reflected signals; and (3) Carr specifically teaches that its analog, continuous micromirrors would be useful for power control applications in WDM systems. Ex. 1005 at 11:20–23.

The prior art teaches that continuously controllable mirrors were an interchangeable alternative to digital (discrete-step) mirrors.

See, e.g., Ex. 1007 at [0030]; Ex. 1008 at 9:9–15; Ex. 1033 at 2:7–9, 3:41–57. A PHOSITA would have known that MEMS mirrors based on analog voltage control can be tilted to any desired angle in their operation range. Ex. 1016 ¶¶ 145-147, Drabik Decl.

A PHOSITA would have known to use continuously controllable mirrors to equalize or otherwise attenuate an optical signal. Carr teaches that the mirrors "can be tilted to any desired orientation" and that "[f]ine control over the mirror orientation" provides "fine control of the degree of attenuation." Ex. 1005 at 1:49–50, 3:47–48, 11:20–23. In addition, other prior art references recognize that having individual control over each channel of an optical signal by continuously altering the position of each mirror provides control on a channel basis and allows for power balancing. See, e.g., Ex. 1007 at [0017], [0038]. Thus, a PHOSITA would have been motivated to use continuously controllable micromirrors of Carr in the device of Bouevitch to equalize or otherwise attenuate an optical signal.

As another example, a PHOSITA would have been motivated to combine the power control method and input/output ports of Carr in the COADM of Bouevitch. Ex. 1016 ¶ 148, Drabik Decl. Bouevitch discloses a COADM where multi-wavelength light is spatially dispersed into channels by a diffraction grating and each channel is reflected by a different mirror in a MEMS array along a different path for adding and dropping optical signals. Ex. 1002 at 14:14–15:18, FIG. 11. Carr discloses a power control method of orienting each of the double-gimbaled, two axis movable MEMS mirrors so that only a portion of a signal reflected off each MEMS mirror enters an optical fiber. Ex. 1005 at 11:11–20. A PHOSITA would have known that power control of each channel may be achieved by intentional misalignment of the reflected beam so that only a portion of the signal enters the output port. *Id.*; see also Ex. 1006 at 4:48–58; Ex. 1007 at [0030], [0038]; Ex. 1008 at 9:9–15.

Bouevitch recognizes that the degree of attenuation may be based on the angle of deflection off each MEMS mirror. Ex. 1002 at 7:31–37. Although Bouevitch does not expressly disclose intentional misalignment into an output port as a method to achieve attenuation, Bouevitch recognizes the principle that angular displacement may be used as the root mechanism to attenuate to signal. *See id.* Bouevitch does not teach away from angular displacement as an attenuation mechanism, rather it only recognizes that there is no need to intentionally misalign a signal into an output port for purposes of attenuation where the signal has already been attenuated elsewhere in the optical system. See id. at 7:41–43 ("As a result the attenuated sub-beam is refracted in the

birefringent element 156 and is directed out of the device to port 102 b.”). Carr teaches that MEMS mirrors may be oriented to intentionally misalign signals into output ports for purposes of power control of each channel. Ex. 1005 at 11:13–25. Additionally, Carr discloses an array of input/output ports through which only a portion of the optical signals may enter for power control. *Id.* at 11:13–33, FIG. 1b. A PHOSITA would have recognized that Carr provides an alternative attenuation technique that does not require the use of birefringent elements as disclosed in Bouevitch. Ex. 1016 ¶ 149, Drabik Decl. Other references expressly state that attenuation by intentional misalignment obviates the need for separate attenuation devices. Ex. 1006 at 4:48–58 (stating that by deliberately misaligning the optical beam path “attenuation is achieved without incorporating separate attenuator(s) within the system”). Thus, a PHOSITA would have been motivated to use the power control method and input/output ports of Carr in the COADM disclosed in Bouevitch, in order to attenuate optical signals. Ex. 1016 ¶ 149, Drabik Decl.

Additionally, the references are in a common field of endeavor (routing optical signals using MEMS-based WSSs), with a finite number of conventional and predictable solutions to the routing issues addressed by the references, such that it would have been obvious to try one of the solutions described in Carr (*e.g.*, two-axis mirrors and misalignment for power control) with the COADM device disclosed in Bouevitch, with a reasonable expectation of success.

Id. at 26–31.

A PHOSITA would have been motivated to combine Bouevitch with Sparks for a number of independent reasons. A PHOSITA would have been motivated to combine Bouevitch with Sparks for many of the same reasons as discussed above with respect to the combination of Bouevitch and Carr. Thus, the motivations to combine of Ground 1 are incorporated herein by reference.

For example, a PHOSITA would have been motivated to combine the twoaxis movable MEMS mirrors of Sparks in the COADM of Bouevitch based on the teachings of the references, common sense and knowledge generally available to a PHOSITA, as the proposed combination would merely be substituting known elements to yield predictable results. Bouevitch discloses a COADM where multi-wavelength light is spatially dispersed into channels by a diffraction grating and each channel is reflected by a different mirror in an array of MEMS mirrors along a different path for adding and dropping optical signals. Ex. 1002 at 14:14-15:18, Fig.

11. Sparks discloses using movable micromirrors capable of two axes movement so that "each of the channels passing through the switch may be attenuated to whatever degree necessary to achieve the desired effect." Ex. 1006 at 2:30-35; 4:39-47. As a result, using the known two-axis mirrors of Sparks in the Bouevitch COADM entails nothing more than the use of known techniques to improve similar devices. Ex. 1016 ¶¶ 152-159, Drabik Decl.

A PHOSITA also would have been motivated to combine the power control method and input/output ports of Sparks within the COADM of Bouevitch. Ex. 1016 ¶ 160. Bouevitch discloses a COADM where multi-wavelength light is spatially dispersed into channels by a diffraction grating and each channel is reflected by a different mirror in a MEMS array along a different path for adding and dropping optical signals. Ex. 1002 at 14:14–15:18, FIG. 11. Sparks discloses deliberately misdirecting an optical beam path reflected from a moveable MEMS mirror so that only a portion of the beam power couples into an optical fiber, in order to achieve a desired output power. Ex. 1006 at 4:48–58; 5:1–11.

Bouevitch recognizes that the degree of attenuation may be based on the beam deflection angle imposed by each MEMS mirror. Ex. 1002 at 7:31–37. Although Bouevitch does not expressly disclose intentional misalignment into an output port as a method to achieve attenuation, Bouevitch recognizes the principle that angular displacement may be used as the root mechanism to attenuate a signal. *See id.* Bouevitch does not teach away from angular displacement as an attenuation mechanism, rather it only recognizes that there is no need to deliberately misalign a signal into an output port for purposes of attenuation where the signal has already been attenuated elsewhere in the optical system. *See id.* at 7:41–43 ("As a result the attenuated sub-beam is refracted in the birefringent element 156 and is directed out of the device to port 102 b."). Sparks teaches that MEMS mirrors may be oriented intentionally to misalign signals into output ports for purposes of power control of each channel. Ex. 1006 at 2:26–39; 4:48–58. Additionally, Sparks discloses two input ports and two output ports through which only a portion of the optical signals may enter for power control. *Id.* at 2:66–3:9, FIG. 2b. A PHOSITA would have recognized that Sparks provides an alternative attenuation technique that does not require the use of the additional birefringent elements disclosed in Bouevitch. Ex. 1006 at 4:48–58. Thus, a PHOSITA would have been motivated to use the power control method and input/output ports of Sparks in the COADM disclosed in Bouevitch to attenuate optical signals. *Id.*; Ex. 1016 ¶ 161, Drabik Decl.

> As a further example, a PHOSITA would have been motivated to combine the servo control system of Sparks in the COADM of Bouevitch. Ex. 1016 ¶¶ 162-163, Drabik Decl. It would be obvious to a PHOSITA to combine the internal closed-loop servo control system of Sparks in Bouevitch as an alternative to the detector array used for purposes of gain equalization. Capella admitted that Figure 6b of Bouevitch illustrates a dynamic gain equalizer where detector array 657 is located inside the ROADM next to reflecting mirrors and that Bouevitch uses this approach to "'eliminat[e] the need for external feedback.'" IPR2014-01276, Paper No. 7 at 38–39 (quoting Ex. 1003 at 10:20–22). Sparks discloses a servo-control system within an optical switch that similarly eliminates the need for external feedback. Ex. 1006 at 4:39–67, Fig. 4; A PHOSITA would have been motivated to use the internal feedback system of Sparks in the COADM of Bouevitch "to ensure that the desired degree of attenuation of achieved for each optical signal (or channel)." Ex. 1006 at 2:62–65; *see also* Ex. 1001 at 12:9–15.

Id. at 48–51.

> To the extent Smith does not fully disclose continuous mirror control, Tew discloses this requirement and it would have been obvious to substitute Tew's analog control into the two-axis mirrors of Smith. Ex. 1016 at ¶¶ 168-170, Drabik Decl. A PHOSITA would have been motivated to combine the teachings of these references at least for the following reasons: (1) continuously controlled mirrors were known to be an alternative to digital mirrors; (2) continuously controlled mirrors allow arbitrary positioning of mirrors and provide more precise control of reflected signals; and (3) Tew specifically teaches that its analog, continuous micromirrors would be useful for power control applications in WDM systems. Ex. 1007 at [0017] & [0030]; Ex. 1008 at 5:1-5, 9:11-15.
>
> In addition, analog (continuous) control of the mirrors would be obvious to try because there are only two general options for such control—either analog (continuous) or digital control. Ex. 1007 at [0030] & [0031]; Ex. 1008 at 9:10-10:3. For example, Tew discusses analog control as the alternative to digital control of mirrors to increase the precision of the rotation of the micromirrors. Ex. 1007 at [0059] & [0078]; Ex. 1008 at 18:8-16, 24:1-10. With only two options, both of which were known in the prior art, and both of which were suggested as working solutions for control, a PHOSITA would have expected that analog control would work well with the two axis mirrors of Smith. Ex. 1016 at ¶ 171.

Id. at 58–59.

> . . . To the PHOSITA, Bouevitch and Sparks were combinable for purposes of establishing obviousness under 35 U.S.C. § 103(a). (*Id.*, ¶ 29-37.) Most of the KSR obviousness rationales support combining these two references. (*KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 415-421 (2007); MPEP § 2141.)
>
> First, Bouevitch and Sparks represent analogous art. Both Bouevitch and Sparks are directed to the same field: communication using optical switch multiplexors (Ex. 1003 at 1:10-15 and 31-34; Ex. 1004 at 4:3-14, 33-38, and 59-60). It is noted that Lin and Dueck are similarly directed to optical switch multiplexors (Lin, Ex. 1010 at Title; Dueck, Ex. 1021 at 3:3-5). This is the same field of endeavor as the '368 Patent (Bouevitch, Ex. 1003 Abstract.) Bouevitch and Sparks are both directed to the same application in that field: optical switching for multi-wavelength WDM communications. (Ex. 1003 at Abstract; Ex. 1004 at 2:30-36.) Furthermore, the actuating mirrors of Sparks and Bouevitch are both MEMS-based. (Ex. 1003 at 14:5-10 and 52-65; Ex. 1004 at 4:42-47). As such, Bouevitch and Sparks (and further Lin and Dueck) are analogous art and the PHOSITA would have understood that the teachings of any one reference would be readily applicable to the others. (McLaughlin Decl., Ex. 1028 at ¶ 30.)
>
> Second, the use of Sparks' 2-axis mirrors in Bouevitch's system is a simple substitution of one known, closely-related element for another that obtains predictable results. The 2-axis actuating mirrors are described by Sparks to "precisely direct[] the beam" (Ex. 1004 at 4:21) and to "carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch" (*Id.* at 4:45-47.) The PHOSITA would expect that using the 2-axis MEMS-based mirrors of Sparks for directing a beam of light in place of the 1-axis MEMS-based mirrors of Bouevitch would yield a predictable result of the same functionality (e.g., movement of a reflective service in a first axis) yet with more control (e.g., the reflective surface moving in a second axis in similar manner as the movement in the first axis). (McLaughlin Decl., Ex. 1028 at ¶ 31.) Likewise, the power control teachings of Sparks "may equally be applied to any optical switch utilising any one or more of reflection, refraction and/or diffraction, in which the optical beam path through the switch can be misaligned so as to attenuate the resultant output signal." (Ex. 1004 at 5:58-62; McLaughlin Decl., Ex. 1028 at ¶ 36.) As a result, using the known 2-axis mirrors for power control in the Bouevitch switch is nothing more than the use of known techniques to

improve similar devices with predictable results. (McLaughlin Decl., Ex. 1028 at ¶¶ 30-32, 35-36.)

Third, it would be obvious to try Sparks' 2-axis actuating mirrors in Bouevitch because 2-axis actuating mirrors were among a small number of identified, predictable solutions for mirror actuation and the PHOSITA had a high expectation of success if Bouevitch's 1-axis actuating mirror were to be replaced with Sparks' 2-axis actuating mirror. (McLaughlin Decl., Ex. 1028 at ¶ 32.) Because Sparks already disclosed the use of 2-axis actuating mirrors by the '368 Patent's priority date, the PHOSITA would have a high expectation of success to try 2-axis mirror control in place of Bouevitch's 1-axis actuating mirror, both for switching and power control. (McLaughlin Decl., Ex. 1028 at ¶¶ 31-32, 36.)

Fourth, Sparks and Bouevitch provide explicit motivations to combine the references. Sparks addresses a problem, and is directed to a goal, identified in Bouevitch. Specifically, Bouevitch states that "[i]n WDM systems it is desirable to ensure that all channels have nearly equivalent power." (Ex. [1003] 1:20-22.) Directly on point, Sparks states that "[i]n wavelength division multiplexed (WDM) transmission, it is desirable to control the power of the individual optical channels or wavelengths . . .[o]ne of the simplest methods of control is to maintain each of the power levels of the individual wavelength components (channels) at substantially the same level." (Ex. 1004 at 1:19-25). To maintain the desired equal channel power levels, Sparks teaches "controlled misalignment of the optical beam path so as to achieve a predetermined optical output power . . . If the optical system is being used as part of a WDM system, it is typical for the signal to be demultiplexed into the separate optical channels prior to input to the switch. If desired, each of the channels passing through the switch may be attenuated to whatever degree necessary to achieve the desired effect, e.g. equalisation of optical power across all channels." (Ex. 1004 at 2:24-36.) As such, the PHOSITA would have been motivated to utilize the 2-axis actuating mirror power control feature of Sparks for addressing the need, identified by Bouevitch, to help ensure that all channels have nearly equivalent power. (McLaughlin Decl., Ex. 1028 at ¶¶ 35-37.)

Finally, 2-axis mirrors, as in Sparks, were known to overcome manufacturing deviations by being actuatable to adjust for any unintentional misalignment in 2-axes. (McLaughlin Decl., Ex. 1028 at ¶¶ 34.) In conclusion, the teachings of Bouevitch are combinable with those of Sparks under §103(a).

JDS Uniphase Corp. v. Capella Photonics, Inc., Patent No. RE 42,368, IPR2015-00731, at *21–24 (PTAB Feb. 13, 2015); *see also id.* at 24–60 (discussing motivations to combine while discussing obviousness); *JDS Uniphase Corp. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Patent No. RE42,678, IPR2015-00739 (PTAB Feb. 14, 2015) (applying a similar analysis to the '678 Patent).

IV. P.R. 3-3(c): CLAIM CHARTS

Pursuant to Local P.R. 3-3(c), and subject to Infinera's reservation of rights contained herein, the invalidity claim charts, attached hereto as Appendices A-1–A-21 and B-1–B-21, identify where in each item of prior art each element of each asserted claim is found for the Asserted Claims, including for any element that is governed by pre-AIA 35 U.S.C. § 112, ¶ 6 and/or post-AIA 35 U.S.C. § 112(f), the identity of the structure(s), act(s), or material(s) in each item of prior art that performs the claimed function. The structure(s), act(s), or material(s) identified by Infinera, and the associated structure(s), act(s), or material(s) recited in each item of prior art, perform(s) each element's claimed function. Any elements of the Asserted Claims that are governed by 35 U.S.C. § 112, ¶ 6 and/or post-AIA 35 U.S.C. § 112(f) are identified below in section VI.A.

The cited portions of the prior art references are examples and representative of the content of the prior art references, and should be understood in the context of the reference as a whole, as understood by one of ordinary skill in the art. To the extent any cited prior art reference fails to explicitly teach or suggest one or more limitations of that claim, the limitation would nonetheless have been inherent in and/or implied by the reference and/or obvious to one of ordinary skill in the art at the time of the alleged invention(s), either alone or by the combination of the cited prior art references with any of the other listed references and/or common knowledge disclosing the missing claim limitations. Non-limiting examples of certain

combinations are outlined above. It should be understood that citations within each exhibit are exemplary, not exhaustive, and should not be construed as the sole evidentiary support in the reference.

V. P.R. 3-3(d): INVALIDITY BASED ON INDEFINITENESS, LACK OF ENABLEMENT, AND LACK OF WRITTEN DESCRIPTION

Pursuant to Local P.R. 3-3(d), and subject to Infinera's reservation of rights, Infinera includes below the grounds on which Infinera contends the Asserted Claims are invalid based on indefiniteness, lack of written description, and/or lack of enablement under pre-AIA 35 U.S.C. § 112.

As noted above, Capella has not yet provided a claim construction for any of the terms and phrases that Infinera anticipates will be in dispute. Infinera, therefore, cannot provide a complete list of its indefiniteness, lack of written description, and lack of enablement defenses because Infinera does not know whether Capella will proffer a construction for certain terms and phrases that would be broader than, or inconsistent with, a construction supportable by the disclosure set forth in the specification. Accordingly, Infinera reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to supplement, amend, and/or modify these indefiniteness, lack of written description, and lack of enablement defenses as discovery progresses and in accordance with Capella's claim construction, infringement and validity disclosures.

A. Indefiniteness

Pre-AIA 35 U.S.C. § 112, ¶ 2 contains two requirements: "first, [the claim] must set forth what the applicant regards as his invention and second, it must do so with sufficient particularity and distinctness, i.e., the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotes removed) (quoting *Solomon v.*

Kimberly-Clark Corp., 216 F.3d 1372, 1377 (Fed. Cir. 2000)); *see also Justacomm-Texas Software, LLC, v. Axway, Inc.*, Case No. 6:10-cv-00011-LED, Dkt. No. 1079 at 6 (E.D. Tex. July 5, 2012). "A determination of whether a claim recites the subject matter which the applicant regards as his invention and is sufficiently definite, so as to satisfy the requirements of 35 U.S.C. § 112, ¶ 2, is a legal conclusion . . . ." *Allen Eng'g*, 299 F.3d at 1343. Under the first requirement of pre-AIA § 112, ¶ 2, a court must hold a claim invalid "[w]here it would be apparent to one of skill in the art, based on the specification, that the invention set forth in [the] claim is not what the patentee regarded as his invention." *Id.* at 1349.

Under the second requirement of pre-AIA § 112, ¶ 2, a claim is sufficiently definite only if, viewed in light of the specification and prosecution history, it informs those skilled in the art about the scope of the invention with reasonable certainty. *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898 (2014). Various Asserted Claims identified below do not comply with the requirements of pre-AIA 35 U.S.C. § 112, ¶ 2, for failing to particularly point out and distinctly claim "the subject matter which the applicant regards as his invention" for the following reasons. For example, as demonstrated either individually or collectively by the claim elements addressed below, various Asserted Claims fail to inform those skilled in the art about the scope of the invention with reasonable certainty, rendering those claims (and any claims depending therefrom) invalid as indefinite.[24] The following chart identifies the claims in which the identified terms and phrases explicitly appear, although those identified terms and phrases are also incorporated into additional dependent Asserted Claims. Infinera's contentions as to indefiniteness also include those dependent claims. Additionally, to the extent any Asserted

[24] Infinera's analysis is preliminary, and Infinera reserves the right to assert claim constructions other than "indefinite" for each of the terms identified below.

Claim containing the identified limitations or phrases or substantially identical limitations or phrases is not specifically identified in the table below, Infinera still identifies such a claim based on its inclusion of such term or phrase.

Claim Terms / Phrases	**Asserted Claims**	**Category**
"fiber collimators serving as an input port and one or more other ports" / "fiber collimator input port" / "a fiber collimator seving as an input port" / "one or more fiber collimators serving as one or more drop ports" / "fiber collimator add port" / "fiber collimator drop port" / "said fiber collimator serving as said drop ports" / "a fiber collimator serving as an input port" / "one or more fiber collimators serving as one or more add ports" / "one or more fiber collimator serving as drop ports" / "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports" / "multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports" / "fiber collimators providing and serving as an input port for a multi-wavelength optical signal" / "fiber collimators, providing and serving as an input port for a multi-wavelength optical signal" / "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports" / "a fiber collimator input port"	'905 Patent, Claims 23, 32, 47, 49, 51 '906 Patent, Claims 68, 89, 100, 115, 126, 133	1
"a spatial array of beam deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port" / "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports and to control the power of the spectral channel reflected to said output port of the fiber collimator serving as said selected port" / "a spatial array of beam-deflecting	'905 Patent, Claims 23, 47, 49 '906 Patent, Claims 68, 89, 100, 115, 126	1, 2

Claim Terms / Phrases	Asserted Claims	Category
elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports and to control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port, whereby said spectral channels from said fiber collimators serving as said add ports are selectively provided to said output port" / "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports" / "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said fiber collimator output ports" / a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually and continuously controllable to reflect said spectral channels into selected ones of said output ports" / "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels" / "a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed		

Claim Terms / Phrases	Asserted Claims	Category
into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors”		
“beam-deflecting elements”	’905 Patent, Claims 23, 47, 49, 51, 52; ’906 Patent, Claim 133	1
“each of said elements being individually and continuously controllable in two dimensions” / “controlling dynamically and continuously said beam-deflecting elements in two dimensions” / “controlling dynamically and continuously other beam deflecting elements” / “said channel micromirrors being pivotal about two axes and being individually and continuously controllable” / “said channel micromirrors being individually controllable” / said channel micromirrors being pivotal about two axes and being individually and continuously controllable” / “dynamically and continuously controlling said beam-deflecting elements in two dimensions”	’905 Patent, Claims 23, 47, 49, 52 ’906 Patent, Claims 68, 89, 115, 133	1
“reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports” / “reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports” / “reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports” / “reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports” / “reflect said spectral channels into selected ones of said fiber collimator output ports” / “reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports” / “direct said spectral channels into any selected ones of output ports and to control the power of the spectral channels coupled into said selected output ports”	’905 Patent, Claims 23, 47, 49 ’906 Patent, Claims 68, 89, 115, 133	1
“control the power of the spectral channel reflected to said output port or the fiber collimator selected port” / “control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port” / “control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port” / “control the	’905 Patent, Claims 23, 47, 49, 51 ’906 Patent, Claims 68, 115, 133	1

Claim Terms / Phrases	Asserted Claims	Category
power of the spectral channels combined into said output multi-wavelength optical signal" / "control the power of said received spectral channels coupled into said fiber collimator output ports" / "control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels" / "control the power of the spectral channels coupled into said selected output ports"		
"a control unit for controlling each of said beam-deflecting elements"	'905 Patent, Claim 24	1, 2
"a servo-control assembly"	'905 Patent, Claim 25 '906 Patent, Claims 69, 89, 116	1
"a spectral monitor for monitoring power levels of selected ones of said spectral channels" / "a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports" / a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports"	'905 Patent, Claim 25 '906 Patent, Claims 70, 90, 117	1, 2
"a processing unit responsive to said power levels for controlling said beam-deflecting elements" / "a processing unit responsive to said power levels for providing control of said channel micromirrors" "a processing unit responsive to said power levels for providing control of said channel micromirrors" / "a processing unit responsive to said power levels for providing control of said channel micromirrors"	'905 Patent, Claim 25 '906 Patent, Claims 70, 90, 117	1, 2
"said servo-control assembly maintains said power levels at predetermined values" / "said servo-control assembly maintains said power levels at a predetermined value" / "maintaining power levels of said spectral channels directed into said output ports at a predetermining value"	'905 Patent, Claim 26 '906 Patent, Claims 71, 91, 135	1
"second spectral channels"	'905 Patent, Claim 27	1
"alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device" / collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an	'905 Patent, Claim 29 '906 Patent, Claims 72, 92, 100, 118	1, 2

Claim Terms / Phrases	Asserted Claims	Category
alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports" / "collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports" / "collimator-alignment mirrors, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports" / "collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimators, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports"		
"none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator" / "none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator" / "neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator" / "neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator" / "neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator" / "neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"	'905 Patent, Claims 37, 48, 50 '906 Patent, Claims 88, 99, 106, 132	1
"a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels"	'905 Patent, Claim 44	1, 2
"the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port"	'905 Patent, Claim 45	1, 2
"imaging each of said spectral channels onto a corresponding beam-deflecting element" / "imaging other spectral channels onto other corresponding beam-	'905 Patent, Claims 51, 52	1

Claim Terms / Phrases	**Asserted Claims**	**Category**
deflecting elements"		
"an output port that transmits the output multi-wavelength optical signal to an optical fiber"	'905 Patent, Claim 51	1
"maintaining a predetermined coupling"	'906 Patent, Claims 69, 89, 116, 134	1
"any selected ones of output ports"	'906 Patent, Claim 133	1
"predetermining value"	'906 Patent, Claim 135	1
"said fiber collimator input and output ports are arranged in a one-dimensional array"	'906 Patent, Claim 80	1

The above limitations of the Asserted Claims, even when read in light of the specification and prosecution history, fail to inform with reasonable certainty one of ordinary skill in the art about the scope of the invention. For example, to one skilled in the art, at least the terms identified as part of Category 1 are not adequately defined in the common specification for the Asserted Patents. Their lack of reasonably ascertainable scope is compounded by Capella's overbroad and vague infringement contentions. Thus, the Asserted Claims fail to distinctly claim the subject matter that the applicant regards as the invention and are invalid under the second paragraph of pre-AIA 35 U.S.C. § 112. *See Nautilus*, 572 U.S. at 907–911.

In addition, numerous of the claim terms and limitations in the Asserted Claims are indefinite under 35 U.S.C. § 112 because they should be subject to means-plus-function interpretation, and the patent specification fails to disclose adequate structure to perform the claimed function(s). *See Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1348, 1350 (Fed. Cir. 2015). For example, at least the terms identified as part of Category 2 are claimed in purely functional language and "do[] not provide any indication of structure because [they] set[] forth the same black box recitation of structure for providing the same specified function as if the term 'means' had been used." *Id.* at 1348. Nor would these terms be understood by one of ordinary

skill in the art to have a sufficiently definite structure. These terms should therefore be treated as means-plus-function limitations. The common specification of the Asserted Patents fails to provide an adequate disclosure of structure for performing the recited functions claimed for these “nonce”/“means” terms, which are therefore indefinite under 35 U.S.C. § 112, ¶ 2.

B. Lack of Written Description

Various Asserted Claims are invalid for failure to comply with the written description requirement under pre-AIA 35 U.S.C. § 112, ¶ 1. To satisfy the written description requirement, the description must “clearly allow persons of ordinary skill in the art to recognize that [the inventor] invented what is claimed.” *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the test for sufficiency is whether the disclosure of the application relied upon reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date. *Id.*

The test requires an objective inquiry into the four corners of the specification from the perspective of a person of ordinary skill in the art. Based on that inquiry, the specification must describe an invention understandable to that skilled artisan and show that the inventor actually invented the invention claimed. “Whether the written description requirement is satisfied is a fact-based inquiry that will depend on the nature of the claimed invention and the knowledge of one skilled in the art at the time an invention is made and a patent application is filed.” *Carnegie Mellon Univ. v. Hoffmann La Roche Inc.*, 541 F.3d 1115, 1122 (Fed. Cir. 2008).

Actual “possession” or reduction to practice outside of the specification is not enough. Rather, as stated above, it is the specification itself that must demonstrate possession. Moreover, while the description requirement does not demand any particular form of disclosure, *id.*, or that the specification recite the claimed invention *in haec verba*, a description that merely renders the invention obvious does not satisfy the requirement. *Lockwood v. Am. Airlines*, 107 F.3d 1565,

1571–72 (Fed. Cir. 1997). Further, a claim fails to satisfy the written description requirement if "the entirety of the specification clearly indicates that the invention is of much narrower scope." *Cooper Cameron Corp. v. Kvaerner Oilfield Prods., Inc.*, 291 F.3d 1317, 1323 (Fed. Cir. 2002) (citing *Gentry Gallery, Inc. v. Berkline Corp.*, 134 F.3d 1473, 1479–80 (Fed. Cir. 1998)).

The specification clearly indicates that the alleged invention is of much narrower scope than what Capella accuses in its Infringement Contentions. The specification explained that "[a] distinct feature" of the alleged invention was that "each channel micromirror" was "individually controllable and moveable, e.g., continuously pivotable (or rotatable):

> In operation, a multi-wavelength optical signal emerges from the input port. The wavelength-separator separates the multi-wavelength optical signal into multiple spectral channels, each characterized by a distinct center wavelength and associated bandwidth. The beam-focuser focuses the spectral channels into corresponding spectral spots. The channel micromirrors are positioned such that each channel micromirror receives one of the spectral channels. ***The channel micromirrors are individually controllable and movable, e.g., continuously pivotable (or rotatable), so as to reflect the spectral channels into selected ones of the output ports***. As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror". And each output port may receive any number of the reflected spectral channels.
>
> A distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that ***the motion, e.g., pivoting (or rotation), of each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted***. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port.

'905 Patent at 4:19–23 (emphasis added). In its Infringement Contentions, however, Capella has accused "LCoS-based switching modules" of satisfying various "beam-deflecting elements" and "channel micromirrors" phrases. Capella describes these "LCoS-based switching modules" as follows:

> The LCoS-based switching modules use a matrix of phase controlled pixels to create a spatial array of channel micromirrors. ***The width of each channel micromirror is controlled by varying the number of pixel columns selected in a first (e.g., horizontal) direction. Channel reflection into a selected fiber collimator output port is controlled by pivoting fibers within the pixels in a second direction (e.g., in a vertical column) and creating optical phase retardation in the direction of the intended deflection.*** The switching module controls beam deflection and optical power by varying the pitch and blaze of the pixels in the columns thereby creating grating patterns. The LCoS array is able to dynamically and continuously control beam reflection and power, dispersion, phase and amplitude. The LCoS is also able to perform additional filter functions.

E.g., Infringement Contentions at 102 (emphasis added) (native PDF pagination). Based on Capella's own description, the "LCoS-based switching modules" themselves are not capable of "motion, e.g., pivoting (or rotation)." There is no disclosure or mention in the Asserted Patents of an "LCoS-based switching module" or even an LCoS array. The specifications of the Asserted Patents do not even include the words Liquid Crystal on Silicon (LCoS) or liquid crystal. The specification demonstrates that the named inventors were not in possession of an apparatus, system, or method that used "LCoS-based switching modules." Every embodiment describing the "channel micromirrors" describes them as being movable/rotatable/pivotable about one or two axes:

> This invention provides a novel wavelength-separating-routing (WSR) apparatus that uses a diffraction grating to separate a multi-wavelength optical signal by wavelength into multiple spectral channels, which are then focused onto an array of corresponding channel micromirrors. ***The channel micromirrors are individually controllable and continuously pivotable*** to reflect the spectral channels into selected output ports.

Id., Abstract (emphasis added).

> In the WSR apparatus of the present invention . . . ***each channel micromirror may be pivotable*** about one or two axes."

Id. at 4:27–37 (emphasis added).

> The channel micromirrors 103 are individually controllable and ***movable, e.g., pivotable (or rotatable) under analog (or continuous) control***, such that, upon reflection, the spectral channels are directed into selected ones of the output ports 110-2 through 110-N by way of the focusing lens 102 and the diffraction grating 101. As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror".

Id. at 7:20–27 (emphasis added).

> Depicted in FIG. 1B is a close-up view of the channel micromirrors 103 shown in the embodiment of FIG. 1A. By way of example, the channel micromirrors 103 are arranged in a one-dimensional array along the x-axis (i.e., the horizontal direction in the figure), so as to receive the focused spots of the spatially separated spectral channels in a one-to-one correspondence. (As in the case of FIG. 1A, only three spectral channels are illustrated, each represented by a converging beam.) ***Let the reflective surface of each channel micromirror lie in the x-y plane as defined in the figure and be movable, e.g., pivotable (or deflectable) about the x-axis in an analog (or continuous) manner***. Each spectral channel, upon reflection, is deflected in the y-direction (e.g., downward) relative to its incident direction, so to be directed into one of the output ports 110-2 through 110-N shown in FIG. 1A.
>
> As described above, a unique feature of the present invention is that the motion of ***each channel micromirror is individually and continuously controllable, such that its position, e.g., pivoting angle, can be continuously adjusted***. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port. To illustrate this capability, FIG. 1C shows a plot of coupling efficiency as a function of a channel micromirror's pivoting angle Θ, provided by a ray-tracing model of a WSR apparatus in the embodiment of FIG. 1A.

Id. at 8:22–45 (emphasis added).

> The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting elements known in the art. And ***each micromirror may be pivoted about one or two axes. What is important is that the pivoting (or rotational) motion of each channel micromirror be individually controllable in an analog manner***, whereby the pivoting angle can be continuously adjusted so as to enable the channel micromirror to scan a spectral channel across all possible output ports.

Id. at 9:22–31 (emphasis added).

> FIG. 3 shows a fourth embodiment of a WSR apparatus according to the present invention. By way of example, WSR apparatus 300 is built upon and hence shares a number of the elements used in the embodiment of FIG. 2B, as identified by those labeled with identical numerals. In this case, the one-dimensional fiber collimator array 110 of FIG. 2B is replaced by a two-dimensional array 350 of fiber collimators, providing for an input-port and a plurality of output ports. Accordingly, the one-dimensional collimator-alignment mirror array 220 of FIG. 2B is replaced by a two-dimensional array 320 of collimator-alignment mirrors, and first and second one-dimensional arrays 260, 270 of imaging lenses of FIG. 2B are likewise replaced by first and second two-dimensional arrays 360, 370 of imagining lenses respectively. As in the case of the embodiment of FIG. 2B, the first and second two-dimensional arrays 360, 370 of imaging lenses are placed in a 4-f telecentric arrangement with respect to the two-dimensional collimator-alignment mirror array 320 and the two-dimensional fiber collimator array 350. ***The channel micromirrors 103 must be pivotable biaxially in this case (in order to direct its corresponding spectral channel to any one of the output ports)***. As such, the WSR apparatus 300 is equipped to support a greater number of the output ports.

Id. at 10:44–67 (emphasis added). Accordingly, the entirety of the specification demonstrates that the alleged invention required that each of the "channel micromirrors" be moveable/pivotable/rotatable. Because each accused "LCoS-based switching module" is *not* itself moveable/pivotable/rotatable, the Asserted Claims fail to satisfy the written description requirement if the scope of the claims is interpreted to encompass an "LCoS-based switching module." For example, if the proper construction of the following limitations under *Phillips* does not require that the recited "channel micromirrors" or "beam-deflecting elements" be moveable/pivotable/rotatable (or moved/pivoted/rotated), the Asserted Claims are invalid for failing to satisfy the written description requirement, along with all claims that depend on the identified Asserted Claims that similarly fail to require that the recited "channel micromirrors" or "beam-deflecting elements" be moveable/pivotable/rotatable (or moved/pivoted/rotated):

Claim Terms	Asserted Claims
"a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port"	'905 Patent, Claim 23
"a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports and to control the power of the spectral channel reflected to said output port of the fiber collimator serving as said selected port, whereby a subset of said spectral channels is directed to said fiber collimator serving as said drop ports"	'905 Patent, Claim 47
"a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports and to control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port, whereby said spectral channels from said fiber collimators serving as said add ports are selectively provided to said output port"	'905 Patent, Claim 49
"controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal"	'905 Patent, Claim 51
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports"	'906 Patent, Claim 68
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said fiber collimator output ports"	'906 Patent, Claim 89

Claim Terms	Asserted Claims
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually and continuously controllable to reflect said spectral channels into selected ones of said output ports"	'906 Patent, Claim 100
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels"	'906 Patent, Claim 115
"a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors"	'906 Patent, Claim 126
"dynamically and continuously controlling said beam-deflecting elements in two dimensions to direct said spectral channels into any selected ones of output ports and to control the power of the spectral channels coupled into said selected output ports"	'906 Patent, Claim 133

A claim also fails to satisfy the written description requirement if, at a minimum, the specification does not describe a negative claim limitation as an alternative feature of the invention. *Inphi Corp. v. Netlist, Inc.*, 805 F.3d 1350, 1356 (Fed. Cir. 2015). Several Asserted Claims recite negative limitations, but the specification fails to describe these limitations as alternative features of the invention, and fails to otherwise demonstrate that the named inventors were in possession of these features. Accordingly, the following claims fail to satisfy the written description requirement, along with any claims dependent on the identified Asserted Claims:

Claim Terms	Asserted Claims
"none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator"	'905 Patent, Claim 37
"none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"	'905 Patent, Claim 48
"none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"	'905 Patent, Claim 50
"neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"	'906 Patent, Claim 88
"neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"	'906 Patent, Claim 99
"neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"	'906 Patent, Claim 106
"neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"	'906 Patent, Claim 132

The specification also states that "other types of beam-deflecting elements known in the art" are a type of "micromirror." *See* '905 Patent at 9:22–25. But claim 46 of the '905 Patent purports to limit "beam-deflecting elements" to "micromirrors," apparently implying that "beam-deflecting elements" are *broader* than micromirrors. Similarly, claim 35 of the '905 Patent purports to limit "beam-deflecting elements" to "micromachined mirrors." To the extent "beam-deflecting elements" are interpreted as broader than micromirrors or micromachined mirrors, the specification does not demonstrate that the named inventors were in possession of the full scope of the alleged invention, the following claims are invalid for failing to satisfy the written description requirement, along with all claims that depend on these Asserted Claims:

Claim Terms	Asserted Claims
"beam-deflecting elements"	'905 Patent, Claims 23, 47, 49, 51 '906 Patent, Claim 133

C. Lack of Enablement

Various Asserted Claims are invalid for failure to comply with the enablement requirement under pre-AIA 35 U.S.C. § 112, ¶ 1. To satisfy the enablement requirement of 35 U.S.C § 112, ¶ 1, the disclosure "must teach those skilled in the art how to make and use the full scope of the claimed invention without 'undue experimentation.'" *Sitrick v. Dreamworks, LLC*, 516 F.3d 993, 999 (Fed. Cir. 2008). Moreover, "[i]t is the specification, not the knowledge of one skilled in the art that must supply the novel aspects of the invention in order to constitute adequate enablement." *Genentech, Inc. v. Novo Nordisk A/S*, 108 F.3d 1361, 1366 (Fed. Cir. 1997). The Federal Circuit has enumerated several factors to consider in determining whether a disclosure would require "undue experimentation": (1) the quantity of experimentation necessary; (2) the amount of direction or guidance presented; (3) the presence or absence of working examples; (4) the nature of the invention; (5) the state of the prior art; (6) the relative skill of those in the art; (7) the predictability or unpredictability of the art; and (8) the breadth of the claims. *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988).

As noted above in discussing the written description requirement, the specification discloses to a person of ordinary skill of the art that each of the channel micromirrors are able to move/rotate/pivot in or to direct its respective spectral channel to "any one of the output ports." The specification fails to disclose any embodiment in which the channel mirrors do not move/rotate/pivot to accomplish that goal. Accordingly, to the extent the scope of the claims is not limited such that "channel micromirrors" or "beam-deflecting elements" be moveable/pivotable/rotatable (or moved/pivoted/rotated), the Asserted Claims are invalid for failing to satisfy the enablement requirement, along with all claims that depend on the identified Asserted Claims that similarly fail to require that the recited "channel micromirrors" or "beam-deflecting elements" be moveable/pivotable/rotatable (or moved/pivoted/rotated), because the

written description fails to teach those skilled in the art how to make and use the full scope of the claimed invention without undue experimentation:

Claim Terms	Asserted Claims
"a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port"	'905 Patent, Claim 23
"a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports and to control the power of the spectral channel reflected to said output port of the fiber collimator serving as said selected port, whereby a subset of said spectral channels is directed to said fiber collimator serving as said drop ports"	'905 Patent, Claim 47
"a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports and to control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port, whereby said spectral channels from said fiber collimators serving as said add ports are selectively provided to said output port"	'905 Patent, Claim 49
"controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal"	'905 Patent, Claim 51
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports"	'906 Patent, Claim 68

Claim Terms	Asserted Claims
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said fiber collimator output ports"	'906 Patent, Claim 89
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually and continuously controllable to reflect said spectral channels into selected ones of said output ports"	'906 Patent, Claim 100
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels"	'906 Patent, Claim 115
"a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors"	'906 Patent, Claim 126
"dynamically and continuously controlling said beam-deflecting elements in two dimensions to direct said spectral channels into any selected ones of output ports and to control the power of the spectral channels coupled into said selected output ports"	'906 Patent, Claim 133

VI. ADDITIONAL GROUNDS OF INVALIDITY AND/OR UNENFORCEABILITY

Although not required by Patent L.R. 3-3 or the Court's Standing Order Regarding Subject Matter Eligibility Contentions, Infinera discloses the following additional theories of invalidity and/or unenforceability of the Asserted Patents and/or the Asserted Claims. Infinera reserves the right to identify additional theories of invalidity and/or unenforceability not required by Patent L.R. 3-3 and to supplement the additional theories identified herein based on further investigation and discovery.

A. Invalidity Under Pre-AIA 35 U.S.C. § 112, ¶ 4

A dependent claim must "contain a reference to a claim previously set forth and then specify a further limitation of the subject matter claimed." Pre-AIA 35 U.S.C. § 112, ¶ 4. A dependent claim's failure to comply with this provision invalidates the claim. *See Pfizer, Inc. v. Ranbaxy Labs. Ltd.*, 457 F.3d 1284, 1292 (Fed. Cir. 2006).

Claims 35 and 46 of the '905 Patent are invalid because they are dependent claims that fail to "specify a further limitation of the subject matter claimed." The specification explains that "[t]he *channel micromirrors* may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting elements known in the art." '905 Patent at 9:22–25. In other words, the specification describes "micromirrors" as a genus and "other beam-deflecting elements" as a species within that genus. By purporting to limit "beam-deflecting elements" to "micromachined mirrors" and "micromirrors," Claims 35 and 46 of the '905 Patent respectively fail to specify a further limitation because they fail to add anything at all (because "beam-deflecting elements" are already by definition "micromirrors" or "micromachined mirrors"), and appear to be an attempt to *broaden* the claim by treating "beam-deflecting elements" as a genus instead of as a species of "micromirrors" or "micromachined mirrors."

B. Improper Reissue

The '905 or '906 patents are invalid, in whole or in part, for failure to meet 35 U.S.C. § 251 et seq.

C. Collateral Estoppel and Res Judicata

In 2016, the Patent Trial and Appeal Board ("PTAB") issued several Final Written Decisions based on Petitions for *Inter Partes Review* ("IPRs") that were filed challenging certain claims of the predecessor '368 and '678 Patents. *See* Exs. 3-8. The PTAB found that a number

of claims in the predecessor ’368 and ’678 Patents were invalid pursuant to 35 U.S.C. § 103 based on various prior art references and cancelled those claims. On February 12, 2018, the Federal Circuit summarily affirmed these decisions in *Capella Photonics, Inc. v. Cisco Systems, Inc.*, *Ciena Corp.*, *Coriant Operations, Inc.*, *Coriant (USA) Inc.*, *Fujitsu Network Communications, Inc.*, *Lumentum Holdings, Inc.*, *Lumentum Inc.*, *Lumentum Operations, LLC*, Nos. 2016-2394, 2016-2395, 2017-1105, 2017-1106, 2017-1107, 2017-1108. *See* Ex. 13. On April 16, 2018, the Federal Circuit issued its mandate. *See* Ex. 14. On November 5, 2018, the United States Supreme Court denied a Petition for Writ of Certiorari filed by Capella. *See* Ex. 15. Accordingly, the PTAB’s Final Written Decisions and the Federal Circuit’s affirmance of those decisions are final and non-appealable. In its Complaint, Capella alleges that “[o]ne or more claims of the ’905 patent is substantially identical to one or more claims of the original ’368 patent[]” (Dkt. 1, ¶ 32), and that “[o]ne or more claims of the ’906 patent is substantially identical to one or more claims of the original ’678 patent[]” (*id.*, ¶ 35). According to Capella, one or more claims of the ’905 Patent is substantially identical or substantially similar to one or more claims of the ’368 Patent that was invalidated by the PTAB, and/or one or more claims of the ’906 Patent is substantially identical or substantially similar to one or more claims of the ’678 Patent that was invalidated by the PTAB. Accordingly, Capella is collaterally estopped from challenging the invalidity of such claims. Capella is also collaterally estopped from challenging determinations necessary to support the PTAB’s judgments in the IPRs, including, for example and without limitation, determinations by the PTAB that (1) certain materials are prior art, (2) disclosures from certain materials teach certain claim limitations, and/or (3) a person of ordinary skill in the art would have been motivated to combine certain teachings.

Further, to the extent that any claims in the ’905 and ’906 Patents are deemed substantially identical to claims in the ’368 and ’678 Patents that were not invalidated in IPR proceedings, Plaintiff could have asserted such claims in the prior lawsuit and is barred from asserting such claims under the doctrine of res judicata.

D. Patent Owner Estoppel

In 2016, the Patent Trial and Appeal Board (“PTAB”) issued several Final Written Decisions based on Petitions for *Inter Partes Review* that were filed challenging certain claims of the ’368 and ’678 Patents. The PTAB found that a number of claims in the predecessor ’368 and ’678 Patents were invalid pursuant to 35 U.S.C. § 103 based on various prior art references and cancelled those claims. Accordingly, pursuant to 37 C.F.R. § 42.73(d)(3), Capella was and is “precluded from taking action inconsistent with the adverse judgment.” This preclusion includes, but is not limited to, “obtaining in any patent . . . [a] claim that is not patentably distinct from a finally refused or cancelled claim[.]” In its Complaint, Capella alleges that “[o]ne or more claims of the ’905 patent is substantially identical to one or more claims of the original ’368 patent[]” (Dkt. 1, ¶ 32), and that “[o]ne or more claims of the ’906 patent is substantially identical to one or more claims of the original ’678 patent[]” (*id.*, ¶ 35). According to Capella, one or more claims of the ’905 Patent is not patentably distinct from one or more claims of the ’368 Patent that was cancelled by the PTAB, and/or one or more claims of the ’906 Patent is not patentably distinct from one or more claims of the ’678 Patent that was cancelled by the PTAB. Accordingly, (1) such claims are invalid because Capella was estopped from obtaining them from the United States Patent Office and (2) Capella was and is precluded from taking any further action inconsistent with the adverse judgment. As a result, for example and without limitation, Capella is estopped from challenging the invalidity of such claims, and/or Capella is estopped from challenging determinations necessary to support the PTAB’s judgments in the

IPRs, including, for example and without limitation, determinations by the PTAB that (1) certain materials are prior art, (2) disclosures from certain materials teach certain claim limitations, and/or (3) a person of ordinary skill in the art would have been motivated to combine certain teachings.

E. Inequitable Conduct

The ’905 and ’906 patents are each unenforceable due to inequitable conduct in the procurement of the predecessor ’368 and ’678 Patents, the relevant facts and circumstances of which are set forth below. The ’905 and ’906 Patents are unenforceable as a result of inequitable conduct by Capella's CEO, Larry Schwerin, and Barry N. Young, Esq., as well as possibly the other applicant(s), their attorney(s), and/or their agent(s) and/or other person(s) involved in the preparation and/or prosecution of predecessor ’368 and ’678 Patents and related patent applications (collectively with Mr. Schwerin and Mr. Young, the “Applicants”). Each of the Applicants was subject to the duty of disclosure under 37 C.F.R. § 1.56.

Infinera alleges that said inequitable conduct comprised intentional misrepresentations and/or omissions including, without limitation, the failure to disclose one or more references during prosecution in breach of the duty of candor and good faith required by 37 C.F.R. § 1.56, with the intent to deceive the Examiner. Specifically, and as pled in additional detail in the subsequent paragraphs of this defense, CEO Larry Schwerin, prosecuting attorney Barry N. Young, as well as possibly other Applicants, were aware of highly-relevant art that the Patent Office had previously used to reject claims in other Capella patent applications similar to the ’905 and ’906 Patents and to the predecessor ’368 and ’678 Patents cancelled as a result of the grant of the ’905 and ’906 Patents. An example of this art—U.S. Patent No. 6,798,941 (the “Smith patent”) and U.S. Patent Publication No. 2002/0071627 (the “Smith application”)—

claims priority to September 2000 and is thus prior art to both ’905 and ’906 Patents and to the predecessor ’368 and ’678 Patents.

The PTAB relied on Smith patent combinations in finding claims 1-6, 9-13, and 15-22 of the predecessor ’368 Patent and claims 1-4, 9, 10, 13, 17, 19-23, 27, 29, 44-46, 53, and 61-65 of the predecessor ’678 Patent (all challenged claims) invalid in the *Cisco Systems, Inc., Ciena Corp., Coriant Ops., Inc., Coriant (USA) Inc., and Fujitsu Network Communications, Inc. v. Capella Photonics, Inc.*, Case Nos. IPR2014-01166, -01276 cases. The Federal Circuit affirmed the PTAB’s findings, and the determination is now final and non-appealable, confirming the reference’s materiality to the now-invalid claims.

The Smith patent and application explicitly disclosed (1) 2-dimensional (e.g., two-axis) control of micromirrors; and (2) power control using those mirrors. Capella's patent attorneys acknowledged that the Smith patent disclosed these features during the prosecution of other Capella patents, such as U.S. Patent No. 7,352,927 (“’927 patent”) discussed below. This art is highly relevant because the Applicants relied solely on the same two features (2-D mirrors and power control) to attempt to overcome prior art during the prosecution of the predecessor ’368 and ’678 Patents. Despite this acknowledgement, the Applicants sought and obtained reissued claims of the predecessor ’368 and ’678 Patents based on their representation to the Patent Office that those claims were patentable due to narrowing amendments that added nothing more than 2-D mirror control and power control.

While the Applicants did disclose the Smith patent during the reissue proceedings for the ’905 and ’906 patents, the Applicants did not disclose to the Patent Office that the predecessor ’368 and ’678 Patents were subject to an inequitable conduct claim based on the Smith patent in the *Capella Photonics, Inc. v. Tellabs, Inc.*, Case No. 14-cv-03350 (N.D. Cal.); *Capella*

Photonics, Inc. v. Fujitsu Network Communications, Inc., Case No. 14-cv-03349 (N.D. Cal.); *Capella Photonics, Inc. v. Ciena Corp.*, Case No. 14-cv-03351 (N.D. Cal.); and *Capella Photonics, Inc. v. Cisco Systems, Inc.*, Case No. 14-cv-03348 (N.D. Cal.) cases. Furthermore, inequitable conduct cannot be cured by reissue and can impact related patents and applications. *Therasense, Inc. v. Becton, Dickinson and Co.*, 649 F. 3d 1276, 1288-89 (Fed. Cir. 2011) (citations omitted). Applicants also did not attempt to cure their inequitable conduct by seeking examination of the predecessor ’368 and ’678 Patents under 35 U.S.C. § 257.

In addition, there is ample evidence that the Applicants concealed the information about the Smith patent and application from the Patent Office with intent to deceive the Patent Office during the prosecution of the predecessor ’368 and ’678 Patents. This is apparent from at least three additional acts by the Applicants. First, Patent Office rules and regulations required Applicants to identify the nature of the "mistake" forming the legal basis to reissue the predecessor ’368 and ’678 Patents. *E.g.*, 37 CFR 1.175(a)(l). Larry Schwerin, Barry N. Young, as well as possibly other Applicants concealed and then misrepresented this “mistake” in at least two ways. As discussed below, initially, the Applicants tried to avoid admitting that the patents that preceded the predecessor ’368 and ’678 Patents were invalid, and also tried to avoid identifying the invalidating prior art. Subsequently, after they were forced to admit the patents that preceded the predecessor ’368 and ’678 Patents were invalid, the Applicants still failed to disclose the full extent of that "mistake." Instead, as a basis for the "mistake," Applicants pointed the Patent Office to a single reference that it argued lacked the allegedly-novel features in the amended claim limitations. At the same time, Applicants failed to identify more relevant prior art that they were aware of, and that disclosed one or more of those allegedly-novel limitations.

Further demonstrating Applicants' intent to deceive, during Capella's prosecution of the predecessor '368 and '678 Patents, Cappella exploited its earlier failure to disclose the full scope of the prior art. As discussed below, first, when Capella filed its original provisional application (to which it later claimed priority), Capella included a picture of a commercially-available mirror that was controllable in 2-D and admitted it was prior art. Next, when Capella filed the non-provisional application, it excised any mention of these 2-D mirrors or the fact they were prior art. Finally, Capella then took advantage of the fact that the Patent Office Examiner would have been unlikely to review the ten-year-old provisional application. It did so by arguing for the patentability of the reissued claims because Capella had narrowed them to include 2-D mirror control, while at the same time pointing to a single prior art reference that arguably lacked 2-D control.

Further demonstrating Applicants' intent to deceive the Patent Office is the handling of the Smith references during the prosecution of the current Asserted Patents. While Applicants disclosed the material Smith patent to the Patent Office during the prosecution of the '905 and '906 patents, the Applicants chose to not disclose the inequitable conduct challenge that had been made against the predecessor '368 and '678 Patents in view of the Smith references—concealing the prior acts that render the entire patent family, including the '905 and '906 Patents, unenforceable. *Therasense, Inc. v. Becton, Dickinson and Co.*, 649 F. 3d 1276, 1288-89 (Fed. Cir. 2011). Applicants also did not attempt to cure their inequitable conduct by seeking examination of the predecessor '368 and '678 Patents under 35 U.S.C. § 257.

On or about December 29, 2004, named inventor Joseph E. Davis signed a declaration in support of a reissue of U.S. Patent No. 6,625,346. That reissue—RE39,397— became the parent patent to the '678 Patent (which was then subsequently reissued at the '906 Patent). Mr. Davis

declared that he was an inventor of the '346 patent, and that the '346 patent had incorrectly failed to name him as such. At the time, Mr. Davis was President and CEO of Capella. On November 14, 2006, the PTO reissued the ’346 patent as RE39,397. Thus, Joseph Davis was substantively involved in the prosecution of Capella's patents at least as early as 2004. Joseph Davis appears to continue to hold a position as Emeritus Board Member at Capella.

In or about 2005, Larry Schwerin replaced Joseph Davis as CEO of Capella. Larry Schwerin was involved in the prosecution of Capella's patents.

On or about August 8, 2006, a PTO examiner cited the Smith application during the prosecution of another Capella patent, U.S. Patent No. 7,263,253 (“’253 patent”). Joseph Davis, a purported inventor of the predecessor ’368 and ’678 Patents and the ’905 and ’906 Patents, was also a named inventor on the ’253 patent.

On or about January 4, 2007, a Patent Office examiner cited U.S. Patent No. 6,798,941 (the "Smith patent") during the prosecution of another Capella patent, the ’927 patent. Joseph Davis, the inventor the ’905 and ’906 Patents, and the predecessor ’368 and ’678 Patents, was also a named inventor on the ’927 patent. The Examiner (who was a different examiner than the person examining the predecessor ’368 and ’678 Patents) rejected the majority of the claims of the '927 patent based on a combination of the Smith patent and one or more other references. Rejected claim 1 of the '927 patent recited mirrors rotatable in both a "switching axis" as well as an "attenuation axis" to control power.

As a named inventor of the predecessor ’368 and ’678 Patents (and the ’905 and ’906 Patents), Joseph Davis was involved in the prosecution of those patents. In addition, on or near March 16, 2007, Joseph Davis's involvement in the prosecution of Capella's patents continued when Mr. Davis signed a § 1.131 declaration to swear behind a prior art reference that the

Examiner had cited together with the Smith patent in the prosecution of the '927 patent. Thus, Mr. Davis was aware of the Smith patent, the Smith application, and their disclosures at least as early as 2007.

Despite Mr. Davis' awareness of the Smith patent and application, the Smith patent and the Smith application were never cited during the prosecution of the various applications that led to the predecessor '368 and '678 Patents.

The Smith patent and the Smith application are material prior art to the claims of the predecessor '368 and '678 Patents. At least claim 1 of the '368 Patent and claim 61 of the '678 Patent are anticipated by the Smith patent and the Smith application. As discussed in the following paragraphs, this is shown by the fact that the Patent Office asserted (and Capella did not deny) that the Smith patent disclosed each and every one of the limitations of claim 1 of the '927 patent, and because claim 1 of the '368 Patent and claim 61 of the '678 Patent recite the same or similar limitations as claim 1 the '927 patent. The materiality of the Smith patent was confirmed by the PTAB's ruling that the Smith patent in combination with other references rendered obvious claims 1-6, 9-13, and 15-22 of the predecessor '368 Patent and claims 1-4, 9, 10, 13, 17, 19-23, 27, 29, 44-46, 53, and 61-65 of the predecessor '678 Patent in the *Cisco Systems, Inc., Ciena Corp., Coriant Ops., Inc., Coriant (USA) Inc., and Fujitsu Network Communications, Inc. v. Capella Photonics, Inc.*, Case Nos. IPR2014-01166, -01276 *inter partes* reviews—holdings that the Federal Circuit affirmed and that are final and non-appealable.

Claim 1 of the '927 patent, which was rejected based on the Smith patent, was narrower than claim 1 of the predecessor '368 Patent. As shown by the color coding below, the main differences between claim 1 of the '927 patent and claim 1 of the predecessor '368 Patent were that claim 1 of the '927 patent included two limitations that claim 1 of the predecessor '368

Patent lacked—(1) an optical beam expander and relay system; and (2) reducing a non-uniform attenuation of passband due to the diffraction from the edges of the micro-mirrors.

Predecessor Patent RE42,368 Claim 1:	Rejected '927 Patent Claim 1:
1. An optical add-drop apparatus comprising an input port for an input multi-wavelength optical signal having first spectral channels; one or more other ports for second spectral channels; an output port for an output multi-wavelength optical signal; a wavelength-selective device for spatially separating said spectral channels; [and] a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port.	1. Optical apparatus for switching multi-channel optical signals having spectral channels of different wavelengths, comprising: a plurality of input and output ports for optical signals having one or more. of said spectral channels; an optical beam exapander [sic: expander] and relay system adapted to receive the optical signals from one or more of the input ports, the anamorphic system being formed to convert the optical signals to spectral beams having a predetermined elongated beam profile; a wavelength separator for spatially separating the spectral beams into constituent spectral channels; and an array of channel micromirrors, each channel micromirror of the array being positioned to receive one of said constituent spectral channels, the micromirrors being rotatable about a switching axis to switch said one spectral channel to a selected output port; wherein each channel micromirror is rotatable about an attenuation axis to vary the coupling of the switched spectral channel to the selected output port to control a power level of the spectral channel output at such selected port, wherein the attenuation axis is different from the switching axis, wherein the channel micromirrors and/or the input or output ports and/or wavelength separator are configured to reduce a non-uniform attenuation of a passband of the apparatus due to diffraction of a spectral beam from an edge of one or more of the micromirrors, wherein the edge is substantially parallel to the attenuation axis.

For similar reasons, Claim 1 of the '927 patent was also narrower than at least claim 61 of the predecessor '678 Patent.

As the Examiner would later confirm, the Smith patent disclosed every element of claim 1 of the '927 patent except the last limitation of reducing a non-uniform attenuation of passband—a limitation the claims of the predecessor ’368 and ’678 Patents lacked. The applicants for the '927 application did not deny this, but instead argued that it would not have been obvious to combine the Smith patent with other references. Accordingly, the Smith patent also disclosed every claim element of at least claim 1 of the predecessor ’368 Patent. Specifically, the Smith patent disclosed:

> a. An optical add-drop apparatus comprising an input port for an input multiwavelength optical signal having first spectral channels;
>
> b. one or more other ports for second spectral channels;
>
> c. an output port for an output multi-wavelength optical signal;
>
> d. a wavelength-selective device for spatially separating said spectral channels;
>
> e. a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels,
>
> f. each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said ports and to control the power of the spectral channel reflected to said selected port.

The provisional patent application on which the Smith patent and the Smith application are based (Provisional Application No. 60/234,683) shows that the priority date of the Smith patent and Smith application is September 22, 2000—at least with respect to the disclosure of (1) 2-dimensional (e.g., two-axis) control of micromirrors; and (2) power control. This priority date makes the Smith patent and Smith application prior art to all of the ’905 and ’906 Patents and their predecessor ’368 and ’678 Patents. The Smith patent lists the ’683 provisional application and the filing date of that provisional application on its first page. The first paragraph in the Smith patent’s specification claims priority to the ‘683 provisional application. The PTAB held

that the Smith patent was entitled to a priority date of September 22, 2000 based on the provisional application, and the Federal Circuit affirmed that ruling.

The '683 provisional Smith application also shows that Capella knew that the Smith patent and the Smith application were prior art that was directed at the same invention that Capella later claimed in the predecessor ’368 and ’678 Patents. Specifically, the '683 provisional application included the following disclosure (emphasis added):

> According to a preferred embodiment of the invention, the optical throughput of each wavelength channel may be controlled by using a mirror array with ***elements that can be rotated in an analog fashion about two orthogonal axes***. Angular displacement in a first, switching plane, is used to perform an OXC, ADM or other switching function while ***angular displacement about the orthogonal axis is used for power control***.

The non-provisional Smith patent and the Smith application that claimed priority to the '683 provisional also disclosed these features. For example, the Abstract of the Smith patent and the Smith application disclosed (emphasis added):

> A multi-wavelength or white-light optical switch including an array of ***mirrors tiltable about two axes, both to control the switching and to provide variable power transmission*** through the switch, both for optimization and for power equalization between wavelength channels in a multi wavelength signal.

On or about March 23, 2007, Capella's patent attorney—Joshua D. Isenberg—filed a response to the January 4, 2007, Office Action for the '927 patent, admitting that the Smith patent "describes a bi-axial MEMS mirror design that has a frame within a frame," and noting that the Smith patent described a MEMs mirror that could both be "rotated about the switching axis so as to point at the output port of interest" and that could also be "rotated about the attenuation axis to attenuate the power of that particular optical wavelength." At least Mr. Davis and Mr. Schwerin, and possibly other Applicants, were aware of this statement.

On or about June 20, 2007, the Examiner of the '927 patent again rejected the majority of the claims of that patent using the Smith patent in combination with one or more other

references. The Examiner stated that "Smith discloses a multi-channel optical switch the structure of which discloses all of the limitations of claims 1 and 29 except for the specific limitation reducing a non-uniform attenuation of passband due to the diffraction from the edges of the micro-mirrors." At least Mr. Davis and Mr. Schwerin, and possibly other Applicants, were aware of this statement.

On or about August 14, 2007, Capella attorney Mr. Isenberg filed another response. That response did not deny the Examiner's statement quoted in the preceding paragraph. Capella's response also acknowledged that “Smith's micromirrors allow for a continuous range of angles of deflection using relatively compact mirrors that can be grouped in two-dimensional arrays.”

Notably, on information and belief, at or about the time Capella filed the reissue applications that became the predecessor ‘368 and ‘678 Patents, Capella was actively trying to sell its patent portfolio (including the pre-reissue versions of the predecessor ’368 and ’678 Patents), and was likely trying to increase the perceived value of that portfolio and/or prepare it for litigation. Executives at Capella, including Larry Schwerin, would have known that the sale value of the company would be based heavily on the value of its patent portfolio.

On or about June 10, 2010, Capella sought reissue of U.S. Patent Nos. RE39,397 and 6,879,750 that eventually reissued as the predecessor ’368 and ’678 Patents. As part of its application for reissue of the ‘750 patent, on or about March 1, 2011, Capella's CEO Larry Schwerin stated that the ‘750 patent was invalid and needed to be reissued. The only two bases provided by Mr. Schwerin for the reissues were that claim 1 was overbroad and invalid by failing to include limitations related to (1) 2-dimensional (e.g., two-axis) control of micromirrors; and (2) power control (emphasis added):

> "***At least one error upon which reissue is based is*** described as follows: Claim 1 is deemed to be too broad and invalid in view of U.S. Patent No. 6,498,872 to Bouevitch

and further in view of one or more of U.S. Patent No. 6,567,574 to Ma, U.S. Patent No. 6,256,430 to Jin, or U.S. Patent No. 6,631,222 to Wagener ***by failing to include limitations regarding the spatial array of beam deflecting elements being individually and continuously controllable in two dimensions to control the power of the spectral channels*** reflected to selected output ports, as indicated by the amendments to Claim 1 in the Preliminary Amendment referred to above."

As part of Capella's application for reissue of the RE39,397 patent, on or about December 2, 2010, Larry Schwerin made a similar representation (to that cited in the previous paragraph) regarding the reason that he claimed the RE39,397 patent was invalid.

By making these statements, Capella (through the Applicants) only identified (1) 2-D mirror control; and (2) power control as allegedly novel aspects of the predecessor ’368 and ’678 Patents over the prior art for the amended claims.

Applicants then amended the claims of the predecessor ’368 and ’678 Patents, effectively narrowing all 22 claims of the predecessor ’368 Patent, and all but 23 of 67 claims of the predecessor ’678 Patent. The amendments were generally directed at two narrowing limitations: (1) 2-D mirror control; and (2) power control.

Despite this, by that time in 2010, Larry Schwerin, Barry N. Young, as well as possibly other Applicants such as Joseph Davis, were aware of the Smith patent and the Smith application, knew that the Smith patent and the Smith application disclosed beam-deflecting elements that were continuously controllable in two dimensions to control power, and failed to disclose those facts to the Examiner of the reissue applications. Schwerin, Young, and possibly other applicants such as Davis, were aware of the ’683 provisional and its contents. This is because the Smith patent lists on its face the ’683 provisional and the filing date of that provisional, and because the first paragraph in the Smith references’ specification claims priority to the ‘683 provisional application.

The information about the existence and disclosure of the Smith patent and the Smith application is "but-for" material information that should have been disclosed to the Patent Office during the prosecution of applications that became the predecessor ’368 and ’678 Patents. The Examiner's reasons for allowance of both of the predecessor ’368 and ’678 Patents included a statement that the then-cited prior art “does not teach or suggest using channel micromirrors which are both individually and continuously controllable to reflect received spectral channels to any one of the output ports and to control the power of the received spectral channels coupled to the output ports.”

The Smith patent and the Smith application are prior art that is “but-for material” because the Patent Office would not have allowed one or more claims of each of the predecessor ’368 and ’678 Patents had it been aware of the undisclosed Smith patent and the fact that the Smith patent disclosed both 2-axis mirrors and power control. Those were the sole stated limitations on which the Examiner of the predecessor ’368 and ’678 Patents allowed all of the claims of the '368 patents and claims 2-20 and 44-67 of the '678 patent. The but-for materiality was confirmed by the PTAB in the *Cisco Systems, Inc., Ciena Corp., Coriant Ops., Inc., Coriant (USA) Inc., and Fujitsu Network Communications, Inc. v. Capella Photonics, Inc.*, Case Nos. IPR2014-01166, -01276 IPRs when it held that claims 1-6, 9-13, and 15-22 of the predecessor ’368 Patent and claims 1-4, 9, 10, 13, 17, 19-23, 27, 29, 44-46, 53, and 61-65 of the predecessor ’678 Patent were invalid because the Smith reference in combination with other references rendered the challenged claims obvious. The PTAB relied upon the Smith patent for the two-axis mirror and power control limitations. The Federal Circuit affirmed the PTAB’s findings.

Larry Schwerin, Barry N. Young, as well as possibly other Applicants, concealed the information about the Smith patent from the Patent Office with intent to deceive the Patent

Office. One or more of the Applicants stood to profit more from selling off a company with a patent portfolio that was perceived to be relatively stronger due to the reissues.

Mr. Schwerin and Mr. Young also represented to the Patent Office that what became claim 1 of each of the predecessor ’368 and ’678 Patents was patentable over the prior art because of the narrowing amendments regarding 2-axis mirrors and power control. Specifically, Applicants stated for both of the predecessor ’368 and ’678 Patents that the “amendments correct errors and ensure that the amended claims distinguish over the prior art.”

Applicants, however, did not tell the Patent Office that the Smith patent and application disclosed both of the two sole alleged points of novelty in the amended claims. Larry Schwerin, Barry N. Young, as well as possibly other Applicants, knew that the statement that the amended claims distinguished over the prior art was a misrepresentation, because they knew the Smith patent and the Smith application anticipated both of those claims.

As alleged above, Schwerin, Young, as well as possibly other Applicants, and others associated with the prosecution of the predecessor ’368 and ’678 Patents, systematically withheld or obfuscated the relevance of the known prior art. The single most likely explanation for these acts is that they were done with an intent to deceive the Patent Office and obtain patents that could be enforced against Infinera and others.

But there is still further conduct that shows Capella’s specific intent to deceive the PTO.

Capella's attempt to hide the true nature of the "mistake" on which it based the reissues of the predecessor ’368 and ’678 Patents. Capella attempted to hide its “mistake” at two different points in the prosecution of the predecessor ’368 and ’678 Patents. Specifically, Capella began the process of asking the Patent Office to reissue the predecessor ’368 and ’678 Patents through the following sequence of events, which are pled in more detail below:

> a. First, Larry Schwerin, Barry N. Young, as well as possibly other Applicants, attempted to avoid saying anything definitive about the "mistake" in the patents, and tried to avoid identifying problematic prior art.
>
> b. Second, when forced to put something on record, Applicants failed to disclose the full extent of the "mistake." Instead, they chose to disclose only some of the weaker prior art references (over which their proposed claim limitations more easily distinguished), and then disguised the deception using language such as "at least one error upon which reissue is based is…."

At the time of filing its reissue applications for the predecessor '368 and '678 Patents, the Applicants tried to avoid admitting that the patent was invalid and to avoid disclosing relevant prior art despite being required to do so by the Patent Office's rules. (See 37 CFR 1.175(a)(l) and MPEP § 1414.) Instead, Mr. Schwerin initially provided only the following statement in a "Reissue Application Declaration by the Assignee": "Claims 1, 15, 16 and 17 ***may have*** claimed more than there was a right to claim in view of the cited prior art." (emphasis added.)

The Examiner responded by noting that Capella failed to specifically say whether the claims were overbroad and also failed to identify even one specific error (or specific prior art) to support the reissue application (February 15, 2011, Office Action, predecessor '368 Patent) (emphasis added):

> This recitation does not include any specific language pointed out in at least one of the independent claims which provides the basis for reissue. ***The phrase "may have claimed more" also lacks sufficient specificity because it is left to the reader to determine if the claimed subject matter "may have claimed more" in view of the cited art, which is also not identified***, which is a task which lends itself to guessing or trail [sic] and error as to what claim language is too broad. Applicant must identify at least one specific piece of prior art (or combination of references) in order to specifically state at least one error.

The Examiner also noted that "[i]n addition, the oath or declaration, as filed, was printed on paper which needed toner and as a result the oath or declaration is faded and partially illegible."

Only after the Examiner's rejection of the original Reissue Application Declarations did Applicants file a "Replacement Reissue Application Declaration by Assignee" for each of the predecessor ’368 and ’678 Patents. In those declarations, CEO Larry Schwerin stated that "the original Patent [was] wholly or partially inoperative or invalid for the reason that the patentee claimed more than he had a right to claim in the Patent."

Only after the Examiner's rejection of the Declarations did the Applicants disclose to the Patent Office that Claim 1 of each patent to be reissued was "too broad and invalid in view of U.S. Patent No. 6,498,872 to Bouevitch…." Even then, the Applicants hedged this language by noting that the problem with the Bouevitch patent was only one of possibly other errors for which Applicants sought reissue.

Despite this late admission, Larry Schwerin, Barry N. Young, as well as possibly other Applicants, were aware of the real "mistake" and of the Bouevitch patent prior to the first (rejected) reissue application declaration. This awareness is evident from the fact that, when Applicants filed their reissue applications and the initial declarations, the Applicants also filed their amendments to the claims in a way that they could later argue avoided the Bouevitch patent. And there is no question that the Applicants knew of the Bouevitch patent prior to filing the reissue applications: as part of Capella's reissue applications, Applicants filed an Information Disclosure Statement ("IDS") for each reissue which identified the Bouevitch patent.

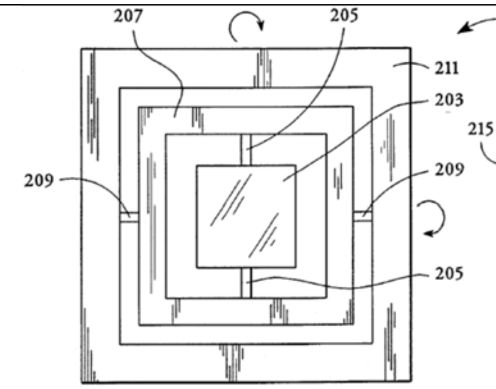
Although the Bouevitch patent was the reference that Applicants later focused on during the reissue process, Applicants' original reissue applications gave no notice that Bouevitch was particularly important. The IDS that Applicants filed contained over two dozen references. U.S. Patent No. 6,498,872 to Bouevitch was listed as reference number 7 on the IDS.

In addition to withholding the true nature of the “mistake” of the invalid, overbroad claims, Applicants also pointed to the Bouevitch patent as a reference that their amendments regarding (1) 2-D mirror control; and (2) power control would more easily overcome, while failing to identify other art that they knew disclosed, for example, a 2-D mirror control (e.g., the Smith patent and the Smith application, discussed above).

Applicants also represented that the "the amendments [to the reissued claims] correct errors and ensure that the amended claims distinguish over the prior art." But, while pointing to the Bouevitch patent, they said nothing about the Smith patent or Smith application.

Applicants also said nothing about another reference with which they were familiar and that clearly disclosed 2-D mirror control – U.S. Patent No. 5,629,790 (the "Neukermans patent"). The Applicants knew of the Neukermans patent because they referenced and (incompletely) characterized its content in the specifications of both of predecessor ’368 and ’678 Patents.

The Neukermans patent clearly disclosed 2-D mirror control, as Applicants would have known, given the Applicants’ description of the Neukermans patent in the specifications of the predecessor ’368 and ’678 Patents (and the ’905 and ’906 Patents). Figure 12a of the Neukermans patent illustrates 2-D mirror 203 and the Neukermans patent states, at Col. 10, lines 17-20, as follows: “The mirror 203 and the surrounding silicon frame 207 have independent driver electrodes so that the mirror 203 can be driven at one rate while the frame 207 may be driven at a second rate.” Neukermans patent at Fig. 12a, 10:17-20:

	"The mirror 203 and the surrounding silicon frame 207 have independent driver electrodes so that the mirror 2.03 can be driven at one rate while the frame 207 may be driven at a second rate"

Despite their awareness of the disclosure of the Neukermans patent, all the Applicants said regarding the Neukermans patent was that "[t]he underlying fabrication techniques for micromachined mirrors and associated actuation mechanisms are well documented in the art, see U.S. Pat. No. 5,629,790 for example." They failed to tell the Patent Office that the reference disclosed 2-D micromachined mirrors and actuation mechanisms. Given that the Applicants' validity claim for the reissued patents was based on a distinction between 1-D and 2- D mirrors, this description of the Neukermans patent was a material misrepresentation, further demonstrating the intentional nature of its conduct.

Another instance that further shows that Applicants intended to deceive the PTO is that at no time during the prosecution of the predecessor '368 and '678 Patents or their parent patents did the Applicants say anything about what they had characterized as a "Prior Art 2-Axis Mirror" (the "Lucent 2- Axis mirror") in the provisional application to which the predecessor '368 and '678 Patents (and the '905 and '906 Patents) claim priority. On page 24 of the '683 provisional application, Applicants stated as follows: "The 2-axis dynamic mirror can take the form of a double-gimbaled torsional mirror. A single-axis torsional mirror is described in Ref. 2, while a two-axis version of such a torsional mirror is described in Ref. 3, and a version developed by Lucent Technologies is shown in Figure 17." Page 24 of that provisional showed:

Prior Art 2-Axis Mirror  Lucent Technologies Bell Labs Innovations	"The 2-axis dynamic mirror can take the form of a double-gimbaled torsional mirror. A single-axis torsional mirror is described in Ref. 2, while a two-axis version of such a torsional mirror is described in Ref. 3, and a version developed by Lucent Technologies is shown in Figure 17."

Despite acknowledging the Lucent 2-Axis mirror as prior art, Larry Schwerin, Barry N. Young, as well as possibly other Applicants, and others associated with the prosecution of the predecessor ’368 and ’678 Patents, failed to acknowledge this Lucent technology as 2-Axis mirror prior art in the non-provisional specifications of the predecessor ’368 and ’678 Patents.

By admitting the existence of this art in the provisional application, but then excising it from the non-provisional applications, the Applicants effectively hid this prior art from the Patent Office.

The Applicants knowingly took advantage of the fact that–without any reason to do so–the Examiner of the predecessor ’368 and ’678 Patents would be unlikely to reach back and examine the provisional application that had been filed ten years earlier. Thus, by amending the claims of the predecessor ’368 and ’678 Patents to claim 2-D mirror controls and then misdirecting the Examiner's attention to the Bouevitch patent that disclosed (arguably) only 1-D mirrors, Larry Schwerin and Barry N. Young, Esq. and possibly other Applicants, purposely omitted information regarding the prior-art 2-D mirrors with an intent to mislead the Patent Office.

Applicants, now including prosecuting attorney Jason Eisenberg, continued to suppress the importance of the Smith patent during the reissue proceedings for the ’905 and ’906 Patents.

While the Applicants did disclose the Smith patent, Applicants were silent about the inequitable conduct allegations. Further, rather than pursue reexamination of the predecessor '368 and '678 Patents under 35 U.S.C. § 257 to address inequitable conduct, Applicants instead elected to abandon the patents in favor of the '905 and '906 Patents. Additionally, Applicants took affirmative steps during the '905 and '906 Patent reissue proceedings to challenge whether the Smith patent qualified as prior art, despite that issue having been finally resolved against Capella in the IPR and appeal proceedings on the predecessor '368 and '678 Patents. In addition to violating 37 C.F.R. § 42.73(d)(3), Applicants' actions further demonstrate the concerted efforts and intent to deceive the Patent Office about the Smith patent.

In sum, given the above facts and circumstances, including: (1) systematically withholding or obfuscating the relevance of the known prior art; (2) multiple attempts to hide the real "mistakes" in the patents that were reissued as the predecessor '368 and '678 Patents; (3) amending claims to highlight distinctions over weaker, disclosed, prior art while withholding art that disclosed some or all of those same distinctions; and (4) continuing to hide its inequitable conduct during the reissue proceedings for the currently-asserted patents, the actions by Larry Schwerin, Barry N. Young, as well as possibly other Applicants, and others associated with the prosecution of the predecessor '368 and '678 Patents, were not caused by some mistake, but instead the single most likely explanation for these acts is that they were done with an intent to deceive the Patent Office and obtain patents that could be enforced against Infinera and others. The Applicants had strong motivations to do so, as they stood to profit from sale of the company at a higher valuation or through a patent licensing campaign if the sale failed.

In addition to being unenforceable due to the inequitable conduct in the procurement of the '368 and '678 Patents, the '905 and '906 Patents are also unenforceable as a result of

inequitable conduct by Jason Eisenberg, Esq. (who prosecuted the reissue proceedings), as well as possibly the other applicant(s), their attorney(s), and/or their agent(s) and/or other person(s) involved in the preparation and/or prosecution of '905 and '906 Patents and related patent applications (collectively the "'905 and '906 Patent Applicants"). Each of the '905 and '906 Patent Applicants was subject to the duties of disclosure, candor, and good faith under 37 C.F.R. § 1.56 and a duty to not take actions inconsistent with an adverse judgment under 37 C.F.R. § 42.73(d)(3).

Infinera alleges that said inequitable conduct comprised intentional misrepresentations including, without limitation, statements during prosecution in breach of the duty of candor and good faith required by 37 C.F.R. § 1.56 and contrary to the adverse judgments against Capella in breach of 37 C.F.R. § 42.73(d)(3), with the intent to deceive the Examiner. Specifically, and as pled in additional detail in the subsequent paragraphs of this defense, prosecuting attorney Jason Eisenberg, as well as possibly other '905 and '906 Patent Applicants, misrepresented the finality of the IPR rulings and the subsequent appeals in order to advocate for different determinations on claim scope and different rulings on prior art status in violation of 37 C.F.R. § 42.73(d)(3) and to attempt to bolster its claim that the reissued claims are substantially identical to the invalidated claims so that it could try to pursue past damages on its nearly expired patents.

The Supreme Court denied Capella's writ petition regarding the IPR determinations (and the Federal Circuit's affirmance of them) on November 5, 2018. Thus, the IPR rulings, including on invalidity, claim construction, and prior art status, were final at least as early as that date. Despite this fact, on March 25, 2019, the '905 Patent Applicants submitted "Second Preliminary Amendment in a Reissue Application under 37 C.F.R. § 1.173(b), Support for all Changes to the Claims, and a Status of Co-Pending Proceedings" that stated that the PTAB's

rulings on the construction of "port" were somehow still not final and were appealable. Specifically, the '905 Patent Applicants stated in regards to the PTAB's finding that Capella had not disavowed circulator ports, "Applicant respectfully disagrees despite the Federal Circuit's affirmance and ***current intends to continue the appeal***" (emphasis added),

The '905 Patent Applicants (Jason Eisenberg, in particular) then proceeded to re-raise its construction and disavowal arguments for the term "port" for the patent family—the arguments that already stood finally rejected. The '906 Patent Applicants included the same multi-page argument regarding the construction of "port" in a "Second Preliminary Amendment" that was also submitted to the Patent Office on March 25, 2019, though the '906 Patent submission did not include the language expressly promising to pursue an appeal that was not available to Capella. The misrepresentations in contravention of the adverse judgment against Capella regarding claim scope and claim construction constitute affirmative egregious misconduct.

In the same March 25, 2019 "Second Preliminary Amendments," the '905 and '906 Patent Applicants argued that the Smith patent was not prior art to the '905 and '906 Patent family. But, the PTAB's determination that the Smith patent was indeed prior art to the family (and the Federal Circuit's affirmance of the PTAB's FWDs) was final and non-appealable by March 25, 2019. The misrepresentations in contravention of the adverse judgment against Capella regarding the established prior art constitutes affirmative egregious misconduct.

The '905 and '906 Patent Applicants' intent to deceive the Patent Office with its misrepresentations regarding claim scope and claim construction regarding "port" is manifest in its allegations and claims for relief in the present case. Despite adding limitations to the '905 and '906 Patent claims during the reissue prosecution, Capella now seeks findings of past infringement and past damages based on its contention that reissued claims are "substantially

identical" to the finally invalidated claims of the predecessor '368 and '678 Patents. During the prosecution of the '905 and '906 Patents, Applicants attempted to avoid expressly conceding that the claim amendments narrowed the claims because conceding that the reissue claim scope was narrowed would invoke intervening rights. Thus, the single most likely reason that the '905 and '906 Patent Applicants wrongly characterized the finality of the prior determinations and advanced arguments inconsistent with the prior adverse rulings is that they intended to deceive the Patent Office. The '905 and '906 Patent Applicants had strong motivations to do so, as they hoped to profit from obfuscating the impact of the reissue amendments so that Capella could try to seek past damages and damages for activities already underway before the reissue date.

The single most likely reason that the '905 and '906 Patent Applicants mischaracterized the finality of the PTAB's determination that the Smith patent was prior art to the '905 and '906 Patent family is that they intended to deceive the Patent Office. As described in detail above, the Smith patent reference disclosed certain claim terms, helping render predecessor '368 and '678 Patent claims invalid (and making it a material reference). The Applicants were also on notice that the Smith patent is at the heart of the inequitable conduct issues plaguing the predecessor '368 and '678 Patents that should render the entire family unenforceable. The '905 and '906 Patent Applicants had strong motivations to attempt to whitewash the Smith patent's materiality through inaccurate and misleading disclosure during the '905 and '906 Patent reissue proceedings because the prior efforts to withhold the Smith patent from the Patent Office should render the family unenforceable. And given the adjudged materiality of the Smith patent to the limitations identified above (which are common to the invalidated '368 and '678 Patent claims and'905 and '906 Patent claims), the '905 and '906 Patent Applicants also had strong

motivations to misrepresent the adjudged prior art status of the Smith patent so that it could get pending claims issued to enforce against Infinera and others before the patents expire.

Dated: August 10, 2020

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that counsel of record who are deemed to have consented to electronic service are being served this 10th day of August, 2020, with a copy of this document via electronic mail.

/s/ Kurt M. Pankratz
Kurt M. Pankratz

EXHIBIT 3

UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

CAPELLA PHOTONICS, INC., Plaintiff v. FUJITSU NETWORK COMMUNICATIONS, INC., Defendant.	Civ. No. 2:20-cv-00076 **JURY TRIAL DEMANDED**

DEFENDANT FUJITSU NETWORK COMMUNICATIONS, INC.'S
INITIAL INVALIDITY CONTENTIONS

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I. INTRODUCTION

Pursuant to the Local Patent Rules and the Court's First Amended Docket Control Order in the above-captioned case (Dkt. No. 36 at 5)[1], Defendant Fujitsu Network Communications, Inc. ("FNC") serves these Invalidity Contentions on Plaintiff Capella Photonics, Inc. ("Capella") for United States Patent Nos. RE47,905 (the "905 Patent") and RE47,906 (the "'906 Patent") (collectively, the "Asserted Patents"). These Invalidity Contentions are based on FNC's current knowledge of the Asserted Patents and prior art, along with its understanding of Capella's infringement allegations set forth in Capella's July 27, 2020 Disclosure of Asserted Claims and Infringement Contentions ("Infringement Contentions"). Based on Capella's Infringement Contentions, Capella is asserting the following claims against FNC (collectively, the "Asserted Claims"):

Patent	**Asserted Claim(s)**
The '905 Patent	23–29, 31–35, 37, 39, and 44–54
The '906 Patent	68–72, 79–85, 87–92, 96–100, 106, 115–118, 122–127, 129–135, and 137–139

FNC submits these Invalidity Contentions without waiving any arguments about the sufficiency or substance of Capella's Infringement Contentions, and without waiving any challenges to Capella's apparent claim constructions. Based in whole or in part on the claim interpretations that Capella appears to be asserting, and its alleged application of those interpretations to the accused instrumentalities, FNC contends that each cited prior art reference

[1] Unless indicated otherwise, docket citations throughout these Invalidity Contentions refer to Civil Action No. 2:20-cv-00076-JRG (E.D. Tex.).

listed below anticipates or renders obvious the Asserted Claims, as described below and in the associated claim charts, attached hereto and incorporated by reference as if fully set forth herein.

Identifying these items of prior art and other defenses in connection with these Contentions does not serve as an admission, or waiver of any argument or position refuting, that any alleged "Accused Instrumentality," including any current or past version of any alleged "Accused Instrumentality," is covered by, or infringes any of the Asserted Claims (or any other claims of the Asserted Patents), particularly when the Asserted Claims are properly construed. Further, FNC's Contentions should not be construed as an admission regarding the proper construction of any asserted claim, should not be deemed to represent or limit the claim constructions that FNC will advance in this action, and should not be deemed to relate to the non-infringement positions FNC may advance in this action.

FNC's Contentions reflect FNC's current knowledge and contentions as of this early date in this action. FNC's Contentions are based in whole or in part on its present understanding of the Asserted Claims and Capella's apparent position as to the scope of the Asserted Claims as applied in its Local Patent Rule 3-1 disclosure. Accordingly, FNC's Contentions (including the attached invalidity claim charts) reflect, to the extent possible, Capella's expected alternative and potentially inconsistent positions as to claim construction and claim scope.

As FNC noted in its Answer (Dkt. No. 14), in 2016, the Patent Trial and Appeal Board ("PTAB") issued several Final Written Decisions based on Petitions for *Inter Partes* Review ("IPRs") that were filed challenging certain claims of U.S. Patents Nos. RE42,368 and RE42,678, which were predecessors to the Asserted Patents. The PTAB found that a number of claims in the predecessor '368 and '678 Patents were invalid pursuant to 35 U.S.C. § 103 based on various prior art references and cancelled those claims. On February 12, 2018, the Federal Circuit summarily

affirmed these decisions in *Capella Photonics, Inc. v. Cisco Systems, Inc., Ciena Corp., Coriant Operations, Inc., Coriant (USA) Inc., Fujitsu Network Communications, Inc., Lumentum Holdings, Inc., Lumentum Inc., Lumentum Operations, LLC*, Nos. 2016-2394, 2016-2395, 2017-1105, 2017-1106, 2017-1107, 2017-1108. On April 16, 2018, the Federal Circuit issued its mandate. On November 5, 2018, the United States Supreme Court denied a Petition for Writ of Certiorari filed by Capella. Accordingly, the PTAB's Final Written Decisions and the Federal Circuit's affirmance of those decisions are final and non-appealable. Accordingly, Capella is collaterally estopped from challenging the invalidity of Asserted Claims in the '905 and '906 Patent that are substantially similar to claims of the predecessor '368 and '678 Patents that were cancelled by the PTAB. *See, e.g.*, *Ohio Willow Wood Co. v. Alps South, LLC*, 735 F.3d 1333, 1342 (Fed. Cir. 2013); *Soverain Software LLC v. Victoria's Secret Direct Brand Mgmt, LLC*, 778 F.3d 1311, 1319 (Fed. Cir. 2015). Capella is also collaterally estopped from challenging determinations necessary to support the PTAB's judgments in the IPRs, including, for example and without limitation, determinations by the PTAB that (1) certain materials are prior art, (2) disclosures from certain materials teach certain claim limitations, and/or (3) a person of ordinary skill in the art would have been motivated to combine certain teachings. FNC incorporates into these Contentions the materials from the PTAB proceedings, the Federal Circuit proceedings, and the Supreme Court proceedings, including but not limited to the petitions for *inter partes* review and the accompanying exhibits, the PTAB's Final Written Decisions, and the Federal Circuit's summary affirmance. This incorporation by reference includes, but is not limited to, identifications and descriptions of prior art, combinations of prior art, and motivations to combine prior art.

Additionally, various defendants served invalidity contentions against the predecessor '368 and '678 Patents. *See, e.g.*, *Capella Photonics, Inc. v. Fujitsu Network Communications, Inc.*, Case

No.: 1:14-CV-20531-PAS (S.D. Fla. May 19, 2014) (Dkt. No. 49). FNC incorporates these previously-served invalidity contentions into the current Contentions by reference, including but not limited to identifications and descriptions of prior art, combinations of prior art, and motivations to combine prior art.

FNC reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to modify and supplement, without prejudice, these Contentions. In addition, FNC reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to raise additional prior art and invalidity defenses not included in these Contentions, including those based on additional discovery or other issues raised by Capella in this action or any related action. FNC further reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to amend these Contentions should, for example, Capella provide any information that it failed to provide in its Initial Disclosures and/or its Infringement Contentions.

Further, because discovery has only recently begun, FNC reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to revise, amend, and/or supplement the information provided herein, including identifying and relying on additional prior art references should FNC's further search and analysis yield additional information or references, consistent with the Local Patent Rules and the Federal Rules of Civil Procedure. FNC expressly reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to rely on witness testimony about the prior art references identified below to supplement these Contentions, where appropriate. Moreover, FNC reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to revise its ultimate Contentions concerning the invalidity of the asserted claims, which may change depending upon the Court's construction of the Asserted Claims, any findings as to the priority date of the Asserted Claims, and/or positions

that Capella or its fact or expert witness(es) may take concerning claim construction, infringement, and/or invalidity issues.

The accompanying invalidity claim charts list specific examples of where prior art references disclose, either expressly or inherently, each limitation of the Asserted Claims and/or examples of disclosures in view of which a person of ordinary skill in the art at the time each of the alleged inventions was made, would have considered each limitation, and therefore the claim as a whole, obvious. The references, however, may contain additional support upon which FNC may rely that is not specifically identified in these contentions. The citations included in each chart are illustrative, not exhaustive. For any given quotation or excerpt, for example, FNC expressly reserves the right to introduce other text and images (including but not limited to surrounding, related, or explanatory text, images, or un-cited portions of the prior art references) from the same or other prior art references that may help to provide context to the quotation or excerpt. Furthermore, where FNC cites to a particular figure in a reference, the citation should be understood to encompass the caption and description of the figure and any text relating, in any manner, to the figure. Similarly, where FNC cites to particular text referring to a figure, the citation should be understood to include the corresponding figure as well. FNC may also rely on other documents and information, including cited references and prosecution histories for the Asserted Patents or related patents (including but not limited to patents and/or patent applications, within the same family or at any time assigned to Capella), and witness testimony, including expert testimony, to explain, amplify, illustrate, demonstrate, provide context or aid in understanding the cited portions of the references.

II. P.R. 3-3(a): IDENTIFICATION OF PRIOR ART

Pursuant to Local Patent Rule 3-3(a), and subject to FNC's reservation of rights, FNC contends that one or more Asserted Claims of the Asserted Patents are anticipated or rendered

obvious by the prior art identified below and as reflected in the attached Appendices (A-1–A-21 and B-1–B-21. FNC also contends that the Accused Instrumentalities do not infringe any Asserted Claim of any Asserted Patent.

FNC reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to assert that the Asserted Claims are invalid under pre-AIA 35 U.S.C. § 102(f) in the event FNC obtains additional evidence that the named inventors of the Asserted Patents did not invent (either alone or in conjunction with others) the subject matter claimed in the Asserted Patents. Should FNC obtain such evidence, it will provide the name of the person(s) from whom, and the circumstances under which, the invention or any part of it was derived.

FNC further intends to rely on admissions of the named inventors and Capella concerning the prior art, including statements found in the Asserted Patents, their prosecution history, and/or other related patents or patent applications, any deposition testimony, and the papers filed and any evidence submitted by Capella in conjunction with this action.

Finally, FNC may rely on testimony from the authors or named inventors listed on the below references.

The following patents and patent publications are prior art to the Asserted Patents under at least pre-AIA 35 U.S.C. §§ 102(a), (b), (e), and/or (g).

Table A-1		
Chart(s)	**Country/Patent Number**	**Publication/Issue Date**
A/B-1	U.S. Patent No. 6,816,640 ("*Tew '640*")[2]	Nov. 9, 2004 (issued)

[2] The application for *Tew '640* was filed on September 28, 2001 and claims priority to Provisional Applications Nos. 60,164,532 (filed on September 29, 2000), 60/236,533 (filed on September 29, 2000), and 60/236,677 (filed on September 29, 2000). Accordingly, based on one or more of these

Table A-1		
Chart(s)	**Country/Patent Number**	**Publication/Issue Date**
A/B-2	U.S. Patent No. 6,618,520 ("*Tew '520*")[3]	Sept. 9, 2003 (issued)
A/B-3	U.S. Patent Application Publ'n No. 2002/0081070 ("*Tew '070*")[4]	June 27, 2002 (published)
A/B-4	U.S. Patent No. 6,798,941 ("*Smith*")[5]	Sept. 28, 2004 (issued)
A/B-5	U.S. Patent No. 6,442,307 ("*Carr*")[6]	Aug. 27, 2002 (issued)
A/B-6	U.S. Patent No. 6,097,859 ("*Solgaard*")[7]	Aug. 1, 2000 (issued)

provisional applications, *Tew '640* is entitled to a priority date of no later than September 29, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

Tew '640 was also published as U.S. Patent Publ'n No. 2002/0044722 on April 18, 2002.

[3] The application for *Tew '520* was filed on September 28, 2001 and claims priority to Provisional Applications Nos. 60/164,223 (filed November 9, 1999) and 60/236,533 (filed September 29, 2000). Accordingly, based on one or more of these provisional applications, *Tew '520* is entitled to a priority date of no later than November 9, 1999 or September 29, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

Tew '520 was also published as U.S. Patent Publ'n No. 2002/0034356 on March 21, 2002.

[4] The application for *Tew '070* was filed on November 13, 2001 and claims priority to U.S. Provisional Application No. 60/250,520 (filed November 30, 2000). Accordingly, based on this provisional application, *Tew '070* is entitled to a priority date of no later than November 30, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[5] The application for *Smith* was filed on September 20, 2001 and claims priority to U.S. Provisional Applications Nos. 60/234,683 (filed September 22, 2000) and 60/267,285 (filed February 7, 2001). Accordingly, based on these provisional applications, *Smith* is entitled to a priority date of no later than September 22, 2000 or February 7, 2001 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

Smith was also published as U.S. Patent Publ'n No. 2002/0071627 on June 13, 2002.

[6] The application for *Carr* was filed on November 3, 2000. Accordingly, *Carr* is entitled to a priority date of no later than November 3, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[7] The application for *Solgaard* was filed on February 12, 1998 and claims priority to U.S. Provisional Application No. 60/038,172 (filed February 13, 1997). Accordingly, based on the utility application and the provisional applications, *Solgarrd* is entitled to a priority date of no later than February 13, 1997 or February 12, 1998 and is prior art under at least pre-AIA 35 U.S.C.

Table A-1		
Chart(s)	**Country/Patent Number**	**Publication/Issue Date**
A/B-7	U.S. Patent No. 6,011,884 ("*Dueck*")[8]	Jan. 4, 2000 (issued)
A/B-8	U.S. Patent No. 7,106,966 ("*Lalonde*")[9]	Sept. 12, 2006 (issued)
A/B-9	U.S. Patent No. 6,253,001 ("*Hoen*")[10]	June 26, 2001 (issued)
A/B-10	U.S. Patent No. 6,625,340 ("*Sparks*")[11]	Sept. 23, 2003 (issued)
A/B-11	U.S. Patent No. 6,498,872 ("*Bouevitch*")[12]	Dec. 24, 2002 (issued)
A/B-12	U.S. Patent No. 6,978,062 ("*Rose*")[13]	Dec. 20, 2005 (issued)

§ 102(e). Additionally, because *Solgaard* issued on August 1, 2000, *Solgaard* is also prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b), and (e).

[8] The application for *Dueck* was filed on December 13, 1997. Accordingly, *Dueck* is entitled to a priority date of no later than December 13, 1997 and is prior art under at least pre-AIA 35 U.S.C. § 102(e). Additionally, because *Dueck* issued on January 4, 2000, *Dueck* is also prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b), and (e).

[9] The application for *Lalonde* was filed on June 1, 2000. Accordingly, *Lalonde* is entitled to a priority date of no later than June 1, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[10] The application for *Hoen* was filed on January 20, 2000. Accordingly, *Hoen* is entitled to a priority date of no later than January 20, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b), and (e).

[11] The application for *Sparks* was filed on December 29, 1999. Accordingly, *Sparks* is entitled to a priority date of no later than December 29, 1999 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[12] The application for *Bouevitch* was filed on December 5, 2000 and claims priority to U.S. Provisional Application No. 60/183,155 (filed February 17, 2000). Accordingly, based on the utility application and the provisional applications, *Bouevitch* is entitled to a priority date of no later than February 17, 2000 or December 5, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[13] The application for *Rose* was filed on February 21, 2001. Accordingly, *Rose* is entitled to a priority date of no later than February 21, 2001 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

Rose was also published as U.S. Patent Application Publ'n No. 2002/0154855 on October 24, 2002.

Table A-1		
Chart(s)	**Country/Patent Number**	**Publication/Issue Date**
A/B-13	U.S. Patent No. 5,661,591 ("*Lin*")[14]	Aug. 26, 1997 (issued)
A/B-14	U.S. Patent No. 5,689,593 ("*Pan*")[15]	Nov. 18, 1997 (issued)
A/B-15	U.S. Patent No. 5,960,133 ("*Tomlinson*")[16]	Sep. 28, 1999 (issued)
A/B-16	U.S. Patent No. 6,658,212 ("*Trutna*")[17]	Dec. 2, 2003 (issued)
A/B-17	U.S. Pat. No. 6,501,877 ("*Weverka*")[18]	Dec. 31, 2002 (issued)
A/B-18	U.S. Patent No. 6,496,291 ("*Raj*")[19]	Dec. 17, 2002 (issued)
A/B-19	U.S. Patent No. 6,583,934 ("*Kramer*")[20]	June 24, 2003 (issued)

[14] The application for *Lin* was filed on September 29, 1995. Accordingly, *Lin* is entitled to a priority date of no later than September 29, 1995 and is prior art under at least pre-AIA 35 U.S.C. § 102(e). Additionally, because *Lin* issued on August 26, 1997, *Lin* is also prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b), and (e).

[15] The application for *Pan* was filed on September 6, 1996, and is a continuation-in-part of U.S. Patent Application No. 08/542,571 (filed October 13, 1995). Accordingly, based on the utility application and the parent application, *Pan* is entitled to a priority date of no later than October 13, 1995 or September 6, 1996 and is prior art under at least pre-AIA 35 U.S.C. § 102(e). Additionally, because *Pan* issued on November 18, 1997, *Pan* is also prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b), and (e).

[16] The application for *Tomlinson* was filed on January 27, 1998. Accordingly, *Tomlinson* is entitled to a priority date of no later than January 27, 1998 and is prior art under at least pre-AIA 35 U.S.C. § 102(e). Additionally, because *Tomlinson* issued on September 28, 1999, *Tomlinson* is also prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b), and (e).

[17] The application for *Trutna* was filed on October 31, 2000. Accordingly, *Trutna* is entitled to a priority date of no later than October 31, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[18] The application for *Weverka* was filed on November 16, 1999. Accordingly, *Weverka* is entitled to a priority date of no later than November 16, 1999 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[19] The application for *Raj* was filed on October 17, 2000. Accordingly, *Raj* is entitled to a priority date of no later than October 17, 2000 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[20] The application for *Kramer* was filed on February 9, 2001 and is a continuation-in-part of U.S. Patent Application No. 09/761,509 (filed January 16, 2001). Accordingly, based on the utility

Table A-1		
Chart(s)	**Country/Patent Number**	**Publication/Issue Date**
A/B-20	U.S. Patent No. 6,263,127 ("*Dragone*")[21]	July 17, 2001 (issued)

The following non-patent publications are prior art to the Asserted Patents under at least pre-AIA 35 U.S.C. §§ 102(a), (b), and/or (g).

Table A-2			
Chart(s)	**Title**	**Publication Date**	**Author(s) / Publisher**
A/B-21	"General Formula for Coupling-loss Characterization of Single-mode Fiber Collimators by Use of Gradient-index Rod Lenses" ("*Yuan*")[22]	May 20, 1999	Shifu Yuan, Nabeel A. Riza / Applied Optics

Moreover, the following references illustrate the state of the art as of March 19, 2001 (what Capella claims is the priority date for the Asserted Claims), along with any references cited or otherwise referred to in these references or any applications (including provisional applications) to which these references claim priority:

- U.S. Patent No. 4,367,040
- U.S. Patent No. 4,707,056
- U.S. Patent No. 4,839,884

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application and the parent application, *Kramer* is entitled to a priority date of no later than February 9, 2001 or January 16, 2001 and is prior art under at least pre-AIA 35 U.S.C. § 102(e).

[21] The application for *Dragone* was filed on May 13, 1999. Accordingly, *Dragone* is entitled to a priority date of no later than May 13, 1999 and is prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b), and (e).

[22] *Yuan* was published May 20, 1999. Accordingly, *Yuan* is entitled to a priority date of no later than May 20, 1999 and is prior art under at least pre-AIA 35 U.S.C. § 102(a) and/or (b).

- U.S. Patent No. 4,844,617
- U.S. Patent No. 5,048,912
- U.S. Patent No. 5,076,692
- U.S. Patent No. 5,233,405
- U.S. Patent No. 5,276,498
- U.S. Patent No. 5,311,606
- U.S. Patent No. 5,315,431
- U.S. Patent No. 5,345,521
- U.S. Patent No. 5,414,540
- U.S. Patent No. 5,450,512
- U.S. Patent No. 5,477,350
- U.S. Patent No. 5,526,155
- U.S. Patent No. 5,600,851
- U.S. Patent No. 5,629,790
- U.S. Patent No. 5,661,591
- U.S. Patent No. 5,740,288
- U.S. Patent No. 5,745,271
- U.S. Patent No. 5,774,244
- U.S. Patent No. 5,835,458
- U.S. Patent No. 5,847,831
- U.S. Patent No. 5,867,264
- U.S. Patent No. 5,868,480
- U.S. Patent No. 5,872,880
- U.S. Patent No. 5,875,272

- U.S. Patent No. 5,881,199
- U.S. Patent No. 5,936,752
- U.S. Patent No. 5,960,133
- U.S. Patent No. 5,943,158
- U.S. Patent No. 5,974,207
- U.S. Patent No. 5,999,306
- U.S. Patent No. 6,069,719
- U.S. Patent No. 6,011,884
- U.S. Patent No. 6,018,603
- U.S. Patent No. 6,028,689
- U.S. Patent No. 6,044,705
- U.S. Patent No. 6,069,719
- U.S. Patent No. 6,081,331
- U.S. Patent No. 6,097,859
- U.S. Patent No. 6,134,042
- U.S. Patent No. 6,134,359
- U.S. Patent No. 6,137,606
- U.S. Patent No. 6,169,624
- U.S. Patent No. 6,172,777
- U.S. Patent No. 6,178,033
- U.S. Patent No. 6,178,284
- U.S. Patent No. 6,193,376
- U.S. Patent No. 6,204,946
- U.S. Patent No. 6,205,269

- U.S. Patent No. 6,222,954
- U.S. Patent No. 6,243,507
- U.S. Patent No. 6,246,818
- U.S. Patent No. 6,253,001
- U.S. Patent No. 6,253,135
- U.S. Patent No. 6,256,430
- U.S. Patent No. 6,259,841
- U.S. Patent No. 6,263,123
- U.S. Patent No. 6,263,127
- U.S. Patent No. 6,263,135
- U.S. Patent No. 6,275,320
- U.S. Patent No. 6,275,623
- U.S. Patent No. 6,285,500
- U.S. Patent No. 6,289,155
- U.S. Patent No. 6,295,154
- U.S. Patent No. 6,300,619
- U.S. Patent No. 6,307,657
- U.S. Patent No. 6,337,753
- U.S. Patent No. 6,343,862
- U.S. Patent No. 6,345,133
- U.S. Patent No. 6,374,008
- U.S. Patent No. 6,381,387
- U.S. Patent No. 6,392,220
- U.S. Patent No. 6,415,070

- U.S. Patent No. 6,415,073
- U.S. Patent No. 6,415,080
- U.S. Patent No. 6,418,250
- U.S. Patent No. 6,424,757
- U.S. Patent No. 6,439,728
- U.S. Patent No. 6,442,307
- U.S. Patent No. 6,453,087
- U.S. Patent No. 6,445,844
- U.S. Patent No. 4,680,645
- U.S. Patent No. 6,498,872
- U.S. Patent No. 6,501,877
- U.S. Patent No. 6,507,421
- U.S. Patent No. 6,538,816
- U.S. Patent No. 6,519,075
- U.S. Patent No. 6,543,286
- U.S. Patent No. 6,549,699
- U.S. Patent No. 6,567,574
- U.S. Patent No. 6,583,934
- U.S. Patent No. 6,600,851
- U.S. Patent No. 6,603,894
- U.S. Patent No. 6,625,340
- U.S. Patent No. 6,635,350
- U.S. Patent No. 6,629,461
- U.S. Patent No. 6,631,222

- U.S. Patent No. 6,634,810
- U.S. Patent No. 6,657,770
- U.S. Patent No. 6,668,108
- U.S. Patent No. 6,687,430
- U.S. Patent No. 6,687,431
- U.S. Patent No. 6,690,885
- U.S. Patent No. 6,694,072
- U.S. Patent No. 6,697,547
- U.S. Patent No. 6,744,173
- U.S. Patent No. 6,760,511
- U.S. Patent No. 6,768,571
- U.S. Patent No. 6,778,739
- U.S. Patent No. 6,792,174
- U.S. Patent No. 6,795,602
- U.S. Patent No. 6,798,941
- U.S. Patent No. 6,798,992
- U.S. Patent No. 6,810,169
- U.S. Patent No. 6,826,349
- U.S. Patent No. 6,842,549
- U.S. Patent No. 6,859,573
- U.S. Patent No. 6,879,750
- U.S. Patent No. 6,898,348
- U.S. Patent No. 6,912,078
- U.S. Patent No. 6,928,244

- U.S. Patent No. 6,950,609
- U.S. Patent No. 6,961,506
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- U.S. Patent No. 7,183,633
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- U.S. Patent Application Publ'n No. 2002/0092963
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III. P.R. 3-3(b): PRIOR ART THAT ANTICIPATES OR RENDERS OBVIOUS ONE OR MORE ASSERTED CLAIMS

Subject to FNC's reservation of rights, FNC identifies the following combinations of prior art now known to FNC that render obvious one or more of the Asserted Claims under pre-AIA 35 U.S.C. § 103. FNC also discloses the motivation to combine such items. FNC reserves the right to assert that any of the identified prior art anticipates one or more of the Asserted Claims under pre-AIA 35 U.S.C. § 102 depending upon the Court's construction of the Asserted Claims, any findings as to the priority date of the Asserted Claims, and/or positions that Capella or its fact or expert witness(es) may take concerning claim construction, infringement, and/or invalidity issues.

To the extent a cited prior art reference is deemed not to by itself to anticipate or render obvious a claim as noted in the attached charts for failing to teach or suggest one or more limitations of that claim, that claim would nonetheless have been obvious to one of ordinary skill in the art at the time of the invention by the combination of the cited prior art reference with one or more other prior art references and/or common knowledge disclosing any missing claim limitations. For example, a person of ordinary skill in the art would have been motivated to combine any reference in Table A-1 and/or Table A-2 with any other reference(s) in Table A-1

and/or Table A-2 and/or one or more of the references identified as illustrating the state of the art. The following includes examples of references that would have been combined by one of ordinary skill in the art.

The following combinations are merely examples. FNC explicitly contends that any of the references identified in Table A-1 and/or Table A-2 and/or the references identified as illustrating the state of the art could be combined to disclose all limitations of the Asserted Claims of the Asserted Patents. Such combinations would be achieved, for example, by merely combining the disclosures documented in the respective claim charts for each reference.

A. Exemplary Combinations

1. Exemplary Combinations Based on Tew ’640 (Charts A/B-1)

Exemplary combinations based on Tew ’640 (Charts A/B-1) include the following:

- **Tew ’640 + Smith**
- **Tew ’640 + Carr**
- **Tew ’640 + Lalonde**
- **Tew ’640 + Hoen**
- **Tew ’640 + Sparks**
- **Tew ’640 + Tomlinson**
- **Tew ’640 + Weverka**
- **Tew ’640 + Kramer**
- **Tew ’640 + Trunta**
- **Tew ’640 + Raj**
- **Tew ’640 + Bouevitch**
- **Tew ’640 + Pan**

- **Tew ’640 + Rose**
- **Tew ’640 + Dragone**
- **Tew ’640 + Tew ’520**
- **Tew ’640 + Tew ’070**
- **Tew ’640 + Dueck**
- **Tew ’640 + Lin**
- **Tew ’640 + Solgaard**
- **Tew ’640 + Yuan**
- **Tew ’640** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Tew ’640** + **Smith** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Carr** + one or more of (**Tew ’520**, **Tew ’070**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Lalonde** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Smith**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Hoen** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Smith**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna,**

Solgaard, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’640 + Sparks** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Smith**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Tomlinson** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Smith, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Weverka** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Smith, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Raj** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Smith, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Rose** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Smith, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’640 + Dragone** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Smith, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Tew ’640 + Kramer** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Smith, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Trutna** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Smith, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Bouevitch** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Smith**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Lin** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Smith**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640 + Pan** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna,**

Solgaard, Yuan, Bouevitch, **Lin**, **Smith,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’640** + **Tew ’520** + one or more of (**Smith**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640** + **Tew ’070** + one or more of (**Tew ’520**, **Smith**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640** + **Dueck** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Smith, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640** + **Solgaard** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Smith, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’640** + **Yuan** + one or more of (**Tew ’520**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Smith, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew '640** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew '520**, **Tew '070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Smith, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

2. Exemplary Combinations Based on Tew '520 (Charts A/B-2)

Exemplary combinations based on Tew '520 (Charts A/B-2) include the following:

- **Tew '520** + **Smith**
- **Tew '520** + **Carr**
- **Tew '520** + **Lalonde**
- **Tew '520** + **Hoen**
- **Tew '520** + **Sparks**
- **Tew '520 + Tomlinson**
- **Tew '520 + Weverka**
- **Tew '520 + Kramer**
- **Tew '520 + Trunta**
- **Tew '520 + Raj**
- **Tew '520 + Bouevitch**
- **Tew '520 + Pan**
- **Tew '520 + Rose**
- **Tew '520 + Dragone**
- **Tew '520 + Tew '640**
- **Tew '520 + Tew '070**
- **Tew '520 + Dueck**

- **Tew ’520 + Lin**
- **Tew ’520 + Solgaard**
- **Tew ’520 + Yuan**
- **Tew ’520** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Tew ’520** + **Smith** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Carr** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Lalonde** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Smith**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Hoen** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Smith**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Sparks** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Smith**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna,**

Solgaard, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’520 + Tomlinson** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Smith, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Weverka** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Smith, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Raj** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Smith, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Rose** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Smith, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Dragone** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Smith, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**

- **Tew ’520 + Kramer** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Smith, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Trutna** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Smith, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Bouevitch** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Smith**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Lin** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Smith**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520 + Pan** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Smith,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520** + **Tew ’640** + one or more of (**Smith**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna,**

Solgaard, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’520** + **Tew ’070** + one or more of (**Tew ’640**, **Smith**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520** + **Dueck** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Smith, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Smith, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520** + **Yuan** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Smith, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’520** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Smith, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

3. Exemplary Combinations Based on Tew ’070 (Charts A/B-3)

Exemplary combinations based on Tew ’070 (Charts A/B-3) include the following:

- **Tew ’070 + Smith**
- **Tew ’070 + Carr**
- **Tew ’070 + Lalonde**
- **Tew ’070 + Hoen**
- **Tew ’070 + Sparks**
- **Tew ’070 + Tomlinson**
- **Tew ’070 + Weverka**
- **Tew ’070 + Kramer**
- **Tew ’070 + Trunta**
- **Tew ’070 + Raj**
- **Tew ’070 + Bouevitch**
- **Tew ’070 + Pan**
- **Tew ’070 + Rose**
- **Tew ’070 + Dragone**
- **Tew ’070 + Tew ’640**
- **Tew ’070 + Tew ’520**
- **Tew ’070 + Dueck**
- **Tew ’070 + Lin**
- **Tew ’070 + Solgaard**
- **Tew ’070 + Yuan**
- **Tew ’070 + Knowledge of a Person of Ordinary Skill in the Art**

- **Tew ’070** + **Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Smith**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Smith**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Sparks** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Smith**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Smith, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna,**

Solgaard, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’070 + Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Smith, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Smith, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Smith, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Dragone** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Smith, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Tew ’070 + Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Smith, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew ’070 + Trutna** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Smith, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Smith**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Smith**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070 + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Smith,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070** + **Tew ’640** + one or more of (**Smith**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew ’070** + **Tew ’520**+ one or more of (**Tew ’640**, **Smith**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna,**

Solgaard, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tew '070** + **Dueck** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Smith, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew '070** + **Solgaard** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Smith, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew '070** + **Yuan** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Smith, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tew '070** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Smith, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

4. Exemplary Combinations Based on Smith (Charts A/B-4)

Exemplary combinations based on Smith (Charts A/B-4) include the following:

- **Smith** + **Tew '070**
- **Smith** + **Carr**
- **Smith** + **Lalonde**

- **Smith** + **Hoen**
- **Smith** + **Sparks**
- **Smith + Tomlinson**
- **Smith + Weverka**
- **Smith + Kramer**
- **Smith + Trunta**
- **Smith + Raj**
- **Smith + Bouevitch**
- **Smith + Pan**
- **Smith + Rose**
- **Smith + Dragone**
- **Smith v+ Tew ’640**
- **Smith + Tew ’520**
- **Smith + Dueck**
- **Smith + Lin**
- **Smith + Solgaard**
- **Smith + Yuan**
- **Smith** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Smith** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Smith + Carr** + one or more of (**Tew '640**, **Tew '520**, **Tew '070**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Lalonde** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Tew '070**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Hoen** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Tew '070**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Sparks** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Tew '070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Tomlinson** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tew '070, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Weverka** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Tew '070, Raj, Rose, Dragone, Dueck, Kramer, Trutna,**

Solgaard, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Smith + Raj** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Tew '070, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Rose** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Tew '070, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Tew '070, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Smith + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Tew '070, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Tew '070, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Smith + Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Tew '070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Lin** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Tew '070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith + Pan** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith** + **Tew '520** + one or more of (**Tew '640**, **Tew '070**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith** + **Dueck** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew '070, Kramer, Trutna,**

Solgaard, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Smith** + **Solgaard** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Tew '070, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith** + **Yuan** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Tew '070, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Smith** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew '640**, **Tew '520**, **Carr**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Tew '070, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

5. <u>Exemplary Combinations Based on Carr (Charts A/B-5)</u>

Exemplary combinations based on Carr (Charts A/B-5) include the following:

- **Carr + Tew '070**
- **Carr** + **Smith**
- **Carr** + **Lalonde**
- **Carr** + **Hoen**
- **Carr** + **Sparks**
- **Carr + Tomlinson**
- **Carr + Weverka**

- **Carr + Kramer**
- **Carr + Trunta**
- **Carr + Raj**
- **Carr + Bouevitch**
- **Carr + Pan**
- **Carr + Rose**
- **Carr + Dragone**
- **Carr v+ Tew '640**
- **Carr + Tew '520**
- **Carr + Dueck**
- **Carr + Lin**
- **Carr + Solgaard**
- **Carr + Yuan**
- **Carr** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Carr** + **Tew '070** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Smith** + one or more of (**Tew '640**, **Tew '520**, **Tew '070**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Carr + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Tew ’070**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Sparks** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Tew ’070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tew ’070, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Tew ’070, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Tew ’070, Rose, Dragone, Dueck, Kramer,**

Trutna, Solgaard, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Carr** + **Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Tew ’070, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr** + **Dragone** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Tew ’070, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Carr** + **Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Tew ’070, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr** + **Trutna** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Tew ’070, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr** + **Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Tew ’070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Carr + Lin** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Tew '070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr + Pan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr** + **Tew '520** + one or more of (**Tew '640**, **Tew '070**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr** + **Dueck** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew '070, Kramer, Trutna, Solgaard, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr** + **Solgaard** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna,**

Tew ’070, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Carr** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Carr** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Solgaard, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

6. Exemplary Combinations Based on Solgaard (Charts A/B-6)

Exemplary combinations based on Solgaard (Charts A/B-6) include the following:

- **Solgaard + Tew ’070**
- **Solgaard** + **Smith**
- **Solgaard** + **Lalonde**
- **Solgaard** + **Hoen**
- **Solgaard** + **Sparks**
- **Solgaard + Tomlinson**
- **Solgaard + Weverka**
- **Solgaard + Kramer**
- **Solgaard + Trunta**
- **Solgaard + Raj**
- **Solgaard + Bouevitch**

- **Solgaard + Pan**
- **Solgaard + Rose**
- **Solgaard + Dragone**
- **Solgaard v+ Tew ’640**
- **Solgaard + Tew ’520**
- **Solgaard + Dueck**
- **Solgaard + Lin**
- **Solgaard + Carr**
- **Solgaard + Yuan**
- **Solgaard** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Solgaard** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Solgaard** + **Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Tew ’070**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Sparks** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Tew ’070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tew ’070, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Tew ’070, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Tew ’070, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Tew ’070, Dragone, Dueck, Kramer,**

Trutna, Carr, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Solgaard + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Tew '070, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Solgaard + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Tew '070, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Tew '070, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Tew '070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard + Lin** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Tew '070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Solgaard + Pan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Tew '520** + one or more of (**Tew '640**, **Tew '070**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Dueck** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew '070, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Carr** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Tew '070, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Solgaard** + **Yuan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna,**

Carr, **Tew '070, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Solgaard** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Dueck, Kramer, Trutna, Carr, Tew '070, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

7. Exemplary Combinations Based on Dueck (Charts A/B-7)

Exemplary combinations based on Dueck (Charts A/B-7) include the following:

- **Dueck + Tew '070**
- **Dueck** + **Smith**
- **Dueck** + **Lalonde**
- **Dueck** + **Hoen**
- **Dueck** + **Sparks**
- **Dueck + Tomlinson**
- **Dueck + Weverka**
- **Dueck + Kramer**
- **Dueck + Trunta**
- **Dueck + Raj**
- **Dueck + Bouevitch**
- **Dueck + Pan**
- **Dueck + Rose**
- **Dueck + Dragone**
- **Dueck + Tew '640**

- **Dueck + Tew ’520**
- **Dueck + Solgaard**
- **Dueck + Lin**
- **Dueck + Carr**
- **Dueck + Yuan**
- **Dueck** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Dueck** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Tew ’070**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Dueck + Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Tew '070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Tomlinson** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tew '070, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Weverka** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Tew '070, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Raj** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Tew '070, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Rose** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Tew '070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Tew '070, Solgaard, Kramer, Trutna,**

Carr, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**

- **Dueck + Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Tew ’070, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Trutna** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Tew ’070, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew ’070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Tew ’070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Dueck** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew ’070, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Dueck** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Lalonde**, **Hoen**, **Sparks**, **Tomlinson, Weverka,**

Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Bouevitch, Lin, **Pan,** and/or **Yuan**)

8. Exemplary Combinations Based on Lalonde (Charts A/B-8)

Exemplary combinations based on Lalonde (Charts A/B-8) include the following:

- **Lalonde + Tew '070**
- **Lalonde + Smith**
- **Lalonde + Dueck**
- **Lalonde + Hoen**
- **Lalonde + Sparks**
- **Lalonde + Tomlinson**
- **Lalonde + Weverka**
- **Lalonde + Kramer**
- **Lalonde + Trunta**
- **Lalonde + Raj**
- **Lalonde + Bouevitch**
- **Lalonde + Pan**
- **Lalonde + Rose**
- **Lalonde + Dragone**
- **Lalonde v+ Tew '640**
- **Lalonde + Tew '520**
- **Lalonde + Solgaard**
- **Lalonde + Lin**
- **Lalonde + Carr**

- **Lalonde + Yuan**
- **Lalonde** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Lalonde** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Sparks** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Tew ’070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Lalonde** + **Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tew ’070, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde** + **Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Tew ’070, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde** + **Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Tew ’070, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde** + **Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Tew ’070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde** + **Dragone** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Tew ’070, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Lalonde** + **Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Tew ’070,**

Trutna, Carr, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Lalonde + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew '070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Lin** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Tew '070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde + Pan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Lalonde** + **Tew '520** + one or more of (**Tew '640**, **Tew '070**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde** + **Solgaard** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew '070, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde** + **Carr** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Tew '070, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde** + **Yuan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lalonde** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Hoen**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

9. <u>Exemplary Combinations Based on Hoen (Charts A/B-9)</u>

Exemplary combinations based on Hoen (Charts A/B-9) include the following:

- **Hoen + Tew '070**

- **Hoen** + **Smith**
- **Hoen** + **Dueck**
- **Hoen** + **Lalonde**
- **Hoen** + **Sparks**
- **Hoen + Tomlinson**
- **Hoen + Weverka**
- **Hoen + Kramer**
- **Hoen + Trunta**
- **Hoen + Raj**
- **Hoen + Bouevitch**
- **Hoen + Pan**
- **Hoen + Rose**
- **Hoen + Dragone**
- **Hoen + Tew ’640**
- **Hoen + Tew ’520**
- **Hoen + Solgaard**
- **Hoen + Lin**
- **Hoen + Carr**
- **Hoen + Yuan**
- **Hoen** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Hoen** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna,**

Carr, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Hoen + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Sparks** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Tew ’070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tew ’070, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Hoen + Weverka** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Tew '070, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Raj** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Tew '070, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Rose** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Tew '070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Hoen + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Tew '070, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Tew**

’070, Carr, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Hoen + Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew ’070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Tew ’070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Hoen** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew ’070, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Hoen** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Sparks**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

10. <u>Exemplary Combinations Based on Sparks (Charts A/B-10)</u>

Exemplary combinations based on Sparks (Charts A/B-10) include the following:

- **Sparks + Tew ’070**
- **Sparks** + **Smith**
- **Sparks** + **Dueck**
- **Sparks** + **Lalonde**
- **Sparks** + **Hoen**

- **Sparks + Tomlinson**
- **Sparks + Weverka**
- **Sparks + Kramer**
- **Sparks + Trunta**
- **Sparks + Raj**
- **Sparks + Bouevitch**
- **Sparks + Pan**
- **Sparks + Rose**
- **Sparks + Dragone**
- **Sparks + Tew '640**
- **Sparks + Tew '520**
- **Sparks + Solgaard**
- **Sparks + Lin**
- **Sparks + Carr**
- **Sparks + Yuan**
- **Sparks** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Sparks** + **Tew '070** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Smith** + one or more of (**Tew '640**, **Tew '520**, **Tew '070**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Bouevitch, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Sparks + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Tew ’070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew ’070, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Tew ’070, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Sparks + Raj** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Tew '070, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Rose** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Tew '070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Sparks + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Tew '070, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Tew ’070, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Sparks + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Tew ’070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew ’070, Kramer, Trutna, Carr, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Sparks** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Yuan, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Sparks** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Bouevitch**, **Lin**, **Pan,** and/or **Yuan**)

11. <u>Exemplary Combinations Based on Bouevitch (Charts A/B-11)</u>

Exemplary combinations based on Bouevitch (Charts A/B-11) include the following:

- **Bouevitch + Tew ’070**
- **Bouevitch** + **Smith**
- **Bouevitch** + **Dueck**
- **Bouevitch** + **Lalonde**
- **Bouevitch** + **Hoen**
- **Bouevitch + Tomlinson**
- **Bouevitch + Weverka**
- **Bouevitch + Kramer**
- **Bouevitch + Trunta**

- **Bouevitch** + **Raj**
- **Bouevitch** + **Sparks**
- **Bouevitch** + **Pan**
- **Bouevitch** + **Rose**
- **Bouevitch** + **Dragone**
- **Bouevitch** + **Tew ’640**
- **Bouevitch** + **Tew ’520**
- **Bouevitch** + **Solgaard**
- **Bouevitch** + **Lin**
- **Bouevitch** + **Carr**
- **Bouevitch** + **Yuan**
- **Bouevitch** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Bouevitch** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Sparks, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Bouevitch + Lalonde** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Tew '070**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch + Hoen** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Tew '070**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch + Tomlinson** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew '070, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch + Weverka** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Tew '070, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch + Raj** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Tew '070, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Bouevitch** + **Rose** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Tew '070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Bouevitch** + **Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Tew '070, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew '070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Lin** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna,**

Carr, Yuan, Sparks, **Tew '070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Bouevitch + Pan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Tew '520** + one or more of (**Tew '640**, **Tew '070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Solgaard** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Tew '070, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Carr** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Tew '070, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Bouevitch** + **Yuan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Bouevitch** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson**, **Weverka, Raj, Rose, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Sparks**, **Lin**, **Pan,** and/or **Yuan**)

12. <u>Exemplary Combinations Based on Rose (Charts A/B-12)</u>

Exemplary combinations based on Rose (Charts A/B-12) include the following:

- **Rose + Tew '070**
- **Rose** + **Smith**
- **Rose** + **Dueck**
- **Rose** + **Lalonde**
- **Rose** + **Hoen**
- **Rose + Tomlinson**
- **Rose + Weverka**
- **Rose + Kramer**
- **Rose + Trunta**
- **Rose + Raj**
- **Rose + Sparks**
- **Rose + Pan**
- **Rose + Bouevitch**

- **Rose + Dragone**
- **Rose + Tew ’640**
- **Rose + Tew ’520**
- **Rose + Solgaard**
- **Rose + Lin**
- **Rose + Carr**
- **Rose + Yuan**
- **Rose** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Rose** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Sparks, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Rose + Hoen** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Tew '070**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Tomlinson** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew '070, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Weverka** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Tew '070, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Raj** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Tew '070, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Tew '070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Rose + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Rose + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Tew '070, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew '070**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Lin** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Tew '070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose + Pan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Sparks, **Lin**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Rose** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Tew ’070, Kramer, Trutna, Carr, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Yuan, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Rose** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Lin**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Rose** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Sparks**, **Lin**, **Pan,** and/or **Rose**)

13. Exemplary Combinations Based on Lin (Charts A/B-13)

Exemplary combinations based on Lin (Charts A/B-13) include the following:

- **Lin + Tew '070**
- **Lin** + **Smith**
- **Lin** + **Dueck**
- **Lin** + **Lalonde**
- **Lin** + **Hoen**
- **Lin + Tomlinson**
- **Lin + Weverka**
- **Lin + Kramer**
- **Lin + Trunta**
- **Lin + Raj**
- **Lin + Sparks**
- **Lin + Pan**
- **Lin + Bouevitch**
- **Lin + Dragone**
- **Lin + Tew '640**
- **Lin + Tew '520**
- **Lin + Solgaard**

- **Lin + Rose**
- **Lin + Carr**
- **Lin + Yuan**
- **Lin** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Lin** + **Tew '070** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Smith** + one or more of (**Tew '640**, **Tew '520**, **Tew '070**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Dueck** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Tew '070**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Lalonde** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Tew '070**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Hoen** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Tew '070**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Sparks, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Lin + Tomlinson** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew '070, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Weverka** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Tew '070, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Raj** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Tew '070, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Tew '070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**

- **Lin + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Tew '070, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew '070**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Rose** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Tew '070**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin + Pan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Sparks, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Lin** + **Tew '520** + one or more of (**Tew '640**, **Tew '070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin** + **Solgaard** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Tew '070, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin** + **Carr** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Tew '070, Yuan, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin** + **Yuan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Sparks**, **Rose**, **Pan,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Lin** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Sparks**, **Rose**, **Pan,** and/or **Yuan**)

14. Exemplary Combinations Based on Pan (Charts A/B-14)

Exemplary combinations based on Pan (Charts A/B-14) include the following:

- **Pan + Tew '070**
- **Pan + Smith**
- **Pan + Dueck**
- **Pan + Lalonde**
- **Pan + Hoen**
- **Pan + Tomlinson**
- **Pan + Weverka**
- **Pan + Kramer**
- **Pan + Trunta**
- **Pan + Raj**
- **Pan + Sparks**
- **Pan + Lin**
- **Pan + Bouevitch**
- **Pan + Dragone**
- **Pan + Tew '640**
- **Pan + Tew '520**
- **Pan + Solgaard**
- **Pan + Rose**
- **Pan + Carr**
- **Pan + Yuan**
- **Pan + Knowledge of a Person of Ordinary Skill in the Art**

- **Pan** + **Tew '070** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Smith** + one or more of (**Tew '640**, **Tew '520**, **Tew '070**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Dueck** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Tew '070**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Lalonde** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Tew '070**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Hoen** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Tew '070**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Tomlinson** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew '070, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Pan + Weverka** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Tew '070, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Raj** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Tew '070, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Tew '070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Pan + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Tew '070, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Pan + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew '070**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Rose** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Tew '070**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan + Lin** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan** + **Tew '520** + one or more of (**Tew '640**, **Tew '070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Pan** + **Solgaard** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Tew '070, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan** + **Carr** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Tew '070, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan** + **Yuan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Pan** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tomlinson, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Sparks**, **Rose**, **Lin,** and/or **Yuan**)

15. Exemplary Combinations Based on Tomlinson (Charts A/B-15)

Exemplary combinations based on Tomlinson (Charts A/B-15) include the following:

- **Tomlinson + Tew '070**
- **Tomlinson** + **Smith**
- **Tomlinson** + **Dueck**

- **Tomlinson** + **Lalonde**
- **Tomlinson** + **Hoen**
- **Tomlinson + Pan**
- **Tomlinson + Weverka**
- **Tomlinson + Kramer**
- **Tomlinson + Trunta**
- **Tomlinson + Raj**
- **Tomlinson + Sparks**
- **Tomlinson + Lin**
- **Tomlinson + Bouevitch**
- **Tomlinson + Dragone**
- **Tomlinson + Tew ’640**
- **Tomlinson + Tew ’520**
- **Tomlinson + Solgaard**
- **Tomlinson + Rose**
- **Tomlinson + Carr**
- **Tomlinson + Yuan**
- **Tomlinson** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Tomlinson** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tomlinson + Smith** + one or more of (**Tew '640**, **Tew '520**, **Tew '070**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Dueck** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Tew '070**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Lalonde** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Tew '070**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Hoen** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Tew '070**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Pan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew '070, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Weverka** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan**, **Tew '070, Raj, Bouevitch, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tomlinson + Raj** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Tew '070, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Tew '070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Tomlinson + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Tew '070, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tomlinson** + **Sparks** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew ’070**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson** + **Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Tew ’070**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson** + **Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Tew ’070, Kramer,**

Trutna, Carr, Yuan, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Tomlinson** + **Carr** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Tew '070, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson** + **Yuan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Tomlinson** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Sparks,** **Rose**, **Lin,** and/or **Yuan**)

16. <u>Exemplary Combinations Based on Trutna (Charts A/B-16)</u>

Exemplary combinations based on Trutna (Charts A/B-16) include the following:

- **Trutna + Tew '070**
- **Trutna** + **Smith**
- **Trutna** + **Dueck**
- **Trutna** + **Lalonde**
- **Trutna** + **Hoen**
- **Trutna + Pan**
- **Trutna + Weverka**

- **Trutna** + **Kramer**
- **Trutna** + **Tomlinson**
- **Trutna** + **Raj**
- **Trutna** + **Sparks**
- **Trutna** + **Lin**
- **Trutna** + **Bouevitch**
- **Trutna** + **Dragone**
- **Trutna** + **Tew ’640**
- **Trutna** + **Tew ’520**
- **Trutna** + **Solgaard**
- **Trutna** + **Rose**
- **Trutna** + **Carr**
- **Trutna** + **Yuan**
- **Trutna** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Trutna** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna** + **Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Trutna + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Tew ’070**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew ’070, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Weverka** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tew ’070, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Raj** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Tew ’070, Bouevitch, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Trutna** + **Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Tew '070, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna** + **Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Trutna** + **Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Tew '070, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna** + **Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna** + **Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew '070**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Trutna + Rose** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Tew '070**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna + Lin** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Tew '070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna** + **Tew '520** + one or more of (**Tew '640**, **Tew '070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna** + **Solgaard** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Tew '070, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna** + **Carr** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna,**

Tew ’070, Yuan, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Trutna** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Trutna** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Weverka, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Rose**, **Lin,** and/or **Yuan**)

17. Exemplary Combinations Based on Weverka (Charts A/B-17)

Exemplary combinations based on Weverka (Charts A/B-17) include the following:

- **Weverka + Tew ’070**
- **Weverka** + **Smith**
- **Weverka** + **Dueck**
- **Weverka** + **Lalonde**
- **Weverka** + **Hoen**
- **Weverka + Pan**
- **Weverka + Tomlinson**
- **Weverka + Kramer**
- **Weverka + Trunta**
- **Weverka + Raj**
- **Weverka + Sparks**

- **Weverka + Lin**
- **Weverka + Bouevitch**
- **Weverka + Dragone**
- **Weverka + Tew ’640**
- **Weverka + Tew ’520**
- **Weverka + Solgaard**
- **Weverka + Rose**
- **Weverka + Carr**
- **Weverka + Yuan**
- **Weverka** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Weverka** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Weverka + Lalonde** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Tew '070**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Hoen** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Tew '070**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Pan** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew '070, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Tomlinson** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tew '070, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Raj** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Tew '070, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Bouevitch** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Tew '070, Dragone, Solgaard, Kramer,**

Trutna, Carr, Yuan, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Weverka + Dragone** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Tew '070, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**
- **Weverka + Kramer** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Tew '070, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Trutna** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Tew '070, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Sparks** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Tew '070**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka + Rose** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Tew '070**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Weverka + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka** + **Tew ’640** + one or more of (**Tew ’070**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka** + **Tew ’520** + one or more of (**Tew ’640**, **Tew ’070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka** + **Solgaard** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Tew ’070, Kramer, Trutna, Carr, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka** + **Carr** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Tew ’070, Yuan, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Weverka** + **Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna,**

Tew ’070, Carr, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Weverka** + **Knowledge of a Person of Ordinary Skill in the Art**)+ one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew ’070, Sparks**, **Rose**, **Lin,** and/or **Yuan**)

18. <u>Exemplary Combinations Based on Raj (Charts A/B-18)</u>

Exemplary combinations based on Raj (Charts A/B-18) include the following:

- **Raj + Tew ’070**
- **Raj** + **Smith**
- **Raj** + **Dueck**
- **Raj** + **Lalonde**
- **Raj** + **Hoen**
- **Raj + Pan**
- **Raj + Tomlinson**
- **Raj + Kramer**
- **Raj + Trunta**
- **Raj + Yuan**
- **Raj + Sparks**
- **Raj + Lin**
- **Raj + Bouevitch**
- **Raj + Dragone**
- **Raj + Tew ’640**

- **Raj + Tew ’520**
- **Raj + Solgaard**
- **Raj + Rose**
- **Raj + Carr**
- **Raj + Weverka**
- **Raj** + **Knowledge of a Person of Ordinary Skill in the Art**
- **Raj** + **Tew ’070** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Smith** + one or more of (**Tew ’640**, **Tew ’520**, **Tew ’070**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Dueck** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Tew ’070**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Lalonde** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Tew ’070**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Raj + Hoen** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Tew ’070**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Pan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Tew ’070, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Tomlinson** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tew ’070, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Yuan** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Tew ’070, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Bouevitch** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Tew ’070, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Dragone** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Tew ’070, Solgaard, Kramer,**

Trutna, Carr, Weverka, Sparks, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**

- **Raj + Kramer** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Tew ’070, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Trutna** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Tew ’070, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Sparks** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Tew ’070**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Rose** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Tew ’070**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj + Lin** + one or more of (**Tew ’640**, **Tew ’520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Tew ’070,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)

- **Raj** + **Tew '640** + one or more of (**Tew '070**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj** + **Tew '520** + one or more of (**Tew '640**, **Tew '070**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj** + **Solgaard** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Raj, Bouevitch, Dragone, Tew '070, Kramer, Trutna, Carr, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj** + **Carr** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Tew '070, Weverka, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj** + **Weverka** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan, Tomlinson, Yuan, Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Sparks**, **Rose**, **Lin,** and/or **Knowledge of a Person of Ordinary Skill in the Art**)
- **Raj** + **Knowledge of a Person of Ordinary Skill in the Art** + one or more of (**Tew '640**, **Tew '520**, **Smith**, **Dueck**, **Lalonde**, **Hoen**, **Pan**, **Tomlinson**, **Yuan**,

Bouevitch, Dragone, Solgaard, Kramer, Trutna, Carr, Tew '070, Sparks, **Rose**, **Lin,** and/or **Weverka**)

B. Motivations to Combine

The Asserted Claims do not represent innovation over the prior art, but instead would be no more than the result of ordinary skill and common sense. No showing of a specific motivation is required to combine the prior art (including the references disclosed above), as each combination would not have produced unexpected results, and at most would simply represent a known alternative to one of skill in the art. See *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 414-17 (2007). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 420. Regardless, motivation to combine or reasons to modify the teachings of the prior art references disclosed herein (including to form the specific exemplary combinations identified above in Section III.A) is found in at least the following: (1) the nature of the problem being solved; (2) the express, implied and inherent teachings of the prior art; (3) the knowledge of persons of ordinary skill in the art; (4) the predictable results obtained in combining the different elements of the prior art according to known methods; (5) the predictable results obtained in simple substitution of one known element for another; (6) the use of a known technique to improve similar devices, methods, or products in the same way; (7) the predictable results obtained in applying a known technique to a known device, method, or product ready for improvement; (8) the finite number of identified predictable solutions that had a reasonable expectation of success; and (9) known work in various technological fields that could be applied to the same or different technological fields based on design incentives or other market forces. The following analysis provides various examples of how these motivations may be specifically applied. This following analysis is not limiting, and goes

beyond the disclosure required by Patent L.R. 3-3(b). FNC reserves the right to present various other examples that fall under the motivations identified above.

1. <u>The Nature of the Problem Being Solved</u>

For example, a person of ordinary skill in the art would have been motivated to combine or modify the prior art (including to form the specific exemplary combinations identified above in Section III.A) based on the nature of the problem being solved. The following are merely examples. To the extent additional relevant sources—such as the Asserted Patents, the prosecution history, or testimony or documents provided by named inventors or companies involved in the development of the technology described in the Asserted Patents—identify additional problems that were allegedly being solved, FNC reserves the right to rely on such problems that were allegedly being solved.

The Asserted Patents identify a number of alleged problems with the prior art, including, for example, (1) alleged high cost (*see, e.g.*, '905 Patent at 2:27–29), (2) alleged optical loss accumulation (*see, e.g.*, *id.*), (3) an alleged inherent difficulty to perform dynamic reconfiguration (*see, e.g.*, *id.* at 2:29–31), (4) an alleged requirement that certain signals and channels share ports, such as an input signal and a pass-through signal, and add channels and drop channels (*see, e.g.*, *id.* at 2:57–63), (5) an alleged requirement for optical circulators (*see, e.g.*, *id.*), (6) an alleged requirement for additional means to "multiplex the add channels before entering the system and to demultiplex the drop channels after exiting the system[]" (*see, e.g.*, *id.* at 2:63–3:2), (7) unnecessary cost and complexity (*see, e.g.*, *id.*), (8) an alleged requirement for precise alignment (*see, e.g.*, *id.* at 3:5–7), (9) an alleged inability to maintain alignment (*see, e.g.*, *id.* at 3:7–8), (10) an alleged lack of mechanisms for "overcoming degradation in the alignment owing to environmental effects such as thermal and mechanical disturbances over the course of operation" (*see, e.g.*, *id.* at 3:7–11), and (11) an alleged lack of "a systematic and dynamic power

management of the power levels of various spectral channels" (*see, e.g.*, *id.* at 3:54–56). A person of ordinary skill in the art would have been motivated to modify or combine the prior art (including to form the specific exemplary combinations identified above in Section III.A) to solve on one or more of these alleged problems. A person of ordinary skill would have been similarly motivated to modify or combine the prior art to achieve a "simple, effective, and economical construction." *See, e.g.*, *id.* at 3:59–61.

2. <u>The Express, Implied and Inherent Teachings of the Prior Art</u>

As another example, a person of ordinary skill would have been motivated to combine or modify the disclosed prior art (including to form the exemplary combinations identified above in Section III.A) based on the express, implied and inherent teachings of the prior art. The following are merely examples of teachings in the prior art, and FNC also incorporates its claim charts (which specifically compare the teachings of the prior art to the limitations of the Asserted Claims) by reference. To the extent the prior art, including the prior art identified throughout these Contentions, provides additional teachings, FNC reserves the right to rely on such teachings. Additionally, FNC reserves the right to rely on passages from the prior art beyond those explicitly quoted or cited below.

For example, the prior art recognized that "[p]urely optical switching, in which the optical beam of the first fiber is coupled directly to a second fiber without significant loss, is much faster" than "mechanical switches," which were typically "slow, large, and very expensive." *See, e.g.*, *Tew '640* at 1:43–55; *see also, e.g.*, *Tew '520* at 1:43–55; *Lalonde* at 1:46–53. The prior art also recognized that "point-to-point" designs using electrical switches did "not integrate well" into "complex network[s]" and that the resulting "number of optical receivers and transmitters" was "very expensive" (*see, e.g.*, *Smith* at 2:43–52), as were the requisite converters (*see, e.g.*, *Lalonde* at 1:46–52). A person of ordinary skill in the art would have been motivated to combine or modify

the prior art in ways that (1) allowed for or moved in the direction of purely optical switching, (2) eliminated electrical/mechanical switches, (3) eliminated conversions from the optical domain to the electrical domain (and vice-versa), and/or (4) minimized optical loss. As another example, the prior art recognized a desire for optical switching that was "low-cost, reliable, and optically efficient[,]" (*see, e.g.*, *Tew* '540 at 3:26–7), and a person of ordinary skill in the art would have been motivated to combine or modify the prior art in ways to achieve those goals. The prior art also that "there [wa]s much interest in all-optical communication networks in which each switching node demultiplexes the multi-wavelength WDM signal from an input fiber into its wavelength components, spatially switches the separate single-wavelength beams in different directions, and multiplexes the switched optical signals for retransmission on one or more output fibers." *See, e.g.*, *Smith* at 2:60–66; *see also, e.g.*, *Hoen* at 1:10–19. A person of ordinary skill in the art would have been motivated to combine or modify the prior art in ways to develop such switching nodes, including but not limited to combining different or modifying prior art references that are directed to or otherwise disclose wavelength-division multiplexing or optical add-drop multiplexers, or combining or modifying prior art to ultimately arrive at a WDM or OADM. The prior art also taught that various disclosures of optical-switching devices (such as WDMs or OADMs) could be modified to different numbers of "input and output fibers" and to use different numbers of "WDM wavelengths." *See, e.g.*, *Smith* at 5:19–21; *see also, e.g.*, *Lalonde* at 5:34–39, 58–62. A person of ordinary skill in the art would have been motivated to combine or modify prior art teachings to either increase or decrease a number of disclosed input and/or output fibers (for example, adding add and/or drop ports). A person of ordinary skill in the art would have also been motivated to combine or modify prior art teachings to handle different numbers of WDM wavelengths. The prior art also taught that the architectures of various types of disclosures of

optical switching (such as, for example, optical cross connects or diffraction grating devices) could be applied to other types of disclosures of optical switching (such as OADMs) (*see, e.g.*, *Smith* at 8:46–59; *see also, e.g.*, *Carr* at 11:11–13; *Lalonde* at 5:17–28; *Rose* at 12:21–22), and a person of ordinary skill would have been motivated to combine or modify the prior art to incorporate disclosures from one type of optical switching (such as optical cross connects) to other types of optical switching (such as OADMs), including but not limited to forming combinations or modifications that would have added add and/or drop ports, or modified existing ports to make them add and/or drop ports.

The prior art also recognized that optical-switching devices (such as WDMs or OADMs) could utilize "additional components" "at the discretion of the optical designer" beyond what is specifically disclosed by any single prior art reference. *See, e.g.*, *Tew '640* at 10:22–25. Indeed, "many variations" of disclosed prior art embodiments were possible. *See, e.g.*, *Smith* at 14:32–33. Examples of components that could be added included but were not limited to "focusing optics" placed between input fibers and wavelength separators, between wavelength combiners and output fibers, and between a mirror array and separators or combiners. *See, e.g.*, *id.* at 10:25–28. The prior art also recognized that multiples of certain components could be used, such as, for example, multiple focusing lenses. *See, e.g.*, *Rose* at 14:49–50. The prior art also recognized that the optical designer had discretion to use substitute components in optical-switching devices (such as WDMs or OADMs) or to use duplicative or multiple components. Examples of such substitute or duplicative components included but were not limited to a single diffraction grating or prism that could replace separators and combiners, or vice versa. *See, e.g.*, *Smith* at 10:28–34. Indeed, the prior art recognized that "wavelength multiplexers and demultiplexers" could be "accomplished in a number of ways typically including dispersive elements such as Bragg gratings, thin-film

interference filter arrays, and arrayed waveguide gratings (AWGs) that spatially separate wavelength components." *See, e.g.*, *id.* at 3:45–50. A person of ordinary skill in the art would have recognized that they could add or substitute components from optical-switching devices (such as WDMs or OADMs) at their discretion, combining various components from the prior art to arrive at their desired optical switching-device. As another example, the prior art also recognized a desire to have a single device with "an optical arrangement suitable for both dynamic gain equalizer (DGE) and configurable optical add/drop multiplexer (COADM) applications" (*see, e.g.*, *Bouevitch* at 1:50–57), and a person of ordinary skill would have been motivated to combine or modify the prior art to arrive at such an optical arrangement. As another example, the prior art recognized a desire to make optical switching devices (such as dynamic gain equalizers and configurable optical add/drop multiplexers) more compact, (*see, e.g.*, *id.* at 1:58–2:21), and a person of ordinary skill would have been motivated to combine or modify the prior art to arrive at such an optical arrangement. As another example, the prior art recognized, in at least certain circumstances, the importance of placing certain optical components—including but not limited to elements having optical power (such as, for example, lenses or spherical mirrors), dispersive or diffraction elements (such as, for example, diffraction gratings), and modifying means (such as, for example, MEMs arrays)—"about one focal length away from each other" (*see, e.g.*, *id.* at 10:22–33, 11:50–58), and a person of ordinary skill would have been motivated to combine or modify the prior art to arrive at such an optical arrangement. As another example, the prior art recognized that a lens has a reflector coincident with a first focal plane, and a diffraction grating coincident with a second focal plane. *See*, *e.g.*, *Bouevitch* at 13:58-64; *see also*, *e.g.*, *Lalonde* at 8:46-51 (discussing demultiplexed wavelengths directed on a MEMS mirror array). A person of ordinary skill would have been motivated to combine or modify the prior art to make an

embodiment "compatible with modifying means based on MEMS technology, for both COADM and DGE applications." *See*, *e.g.*, *Bouevitch* at 13:65-14:1.

The prior art also recognized that it was "well understood by those in the art" that "wave plates" (such as quarter- or half-wave plates) could be inserted, for example, "so as to substantially eliminate polarization dependence within the switch." *See, e.g.*, *Smith* at 5:39–42; *see also, e.g.*, *Solgaard* at 8:18–20; *Bouevitch* at 5:49–60, 7:23–44. A person of ordinary skill would have been motivated to combine or modify prior art disclosures to include wave plates, such as quarter- or half-wave plates to, for example, substantially eliminate polarization dependence or sensitivity.

The prior art also recognized that a first "partially demultiplexed signal array" can be collimated and directed to a grating "where they are reflected and diffracted" to form a "resulting two-dimensional reflected and diffracted signal[]" to form a "demultiplexed signal array." *See*, *e.g.*, *Dragone* at 3:66-4:11; *see also*, e.g., *Dragone* at 3:23-41 ("demultiplexing by imaging all of the partial demultiplexed output port signal of the AWG through a planar diffraction grating onto the final demultiplexed output plane, creating a two-dimensional (2-D) array spots with the fully demultiplexed wavelengths"); *see also*, e.g., *Weverka* at 13:47-59 (discussing a pair of wavelength routers in a back-to-back configuration). A person of ordinary skill would be motivated to combine or modify the prior art to have an auxiliary wavelength separating-routing apparatus by partially and then fully demultiplexing signals, because "partial demultiplexing characteristic of an arrayed waveguide router (AWR) can, advantageously, be combined with a free-space optical router to fully demultiplex an input WDM signal. The two-stage router can be used to obtain output wave length signals in either one- or two-dimensional arrays." *See*, *e.g.*, *Dragone* at 1:36-41.

The prior art also recognized that holding an optical fiber in a ferrule with a collimator lens, such as a self-focusing gradient index (GRIN) lens (what the Asserted Patents arguably

identify as at least one example of "a fiber collimator" *see, e.g.*, '905 Patent at 9:34–38) "simplifies handling of the optical fibers." *See, e.g.*, *Tew '520* at 5:45–50. The prior art similarly recognized that "[c]ollimated light is desired due to the typically small mirror tilt angle provided by common micromirror devices." *See, e.g.*, *id.* at 5:49–51. A person of ordinary skill would have therefore been motivated to combine or modify the prior art to include such fiber collimators (replacing components rendered unnecessary, duplicative, and/or obsolete by such fiber collimators), and to include such fiber collimators specifically in the form of "fiber collimator ports" or fiber collimators "serving as" ports (replacing components rendered unnecessary, duplicative, and/or obsolete by such fiber collimator ports, including other types of ports or components using other types of ports). As another example, the prior art also recognized that input and output fibers (including, for example, add and drop fibers) could be "arranged in, a variety of ways," including placing them side by side, placing one over or under another, and using the same fiber for different paths, the latter arrangement using equipment such as an optical circulator to separate signals." *See, e.g.*, *Solgaard* at 9:14–20. A person of ordinary skill would have been motivated to combine or modify the prior art to accomplish any such fiber arrangements, including, for example, taking a system that uses the same fiber for different paths with an optical circulator, adding fibers (if necessary), separating the paths onto different fibers (arranged, for example, side by side), and removing any optical circulators. *See, e.g.*, *Kramer* at 34:20-28.

As another example, the prior art also recognized that "a more integrated design" "includes the wavelength multiplexing and MEMS switching in a single unit" where "[t]wo input fiber waveguides … and two output fiber waveguides … are aligned linearly parallel to each other." *See*, *e.g.*, *Smith* at 4:16-24 and Fig. 5; *see also*, *e.g.*, *Carr* at Fig. 1B; *Pan* at Fig. 11A; *Solgaard* at 9:13-15; *Raj* at 4:45-52; *Tew '520* at 8:58-9:4, Figs. 5-6, and Fig. 10; *Tew '640* at 8:44-55 and

Figs. 4-8. A person of ordinary skill would be motivated to combine or modify the prior art to have a one-dimensional array of input and output ports such that "the ultimate disposition of each channel on each fiber … may be controlled by the MEMS element … to specifically direct or route each input channel to a particular output fiber" with "relatively high precision" and "compact arrangement." *See*, *e.g.*, *Raj* at 4:45-52.

As another example, the prior art also recognized that micromirror arrays "provide[] precise adjustment of . . . power levels[.]" *See, e.g.*, Tew '070, ¶ 35–38; *see also, e.g.*, *Carr* at 11:11–12:50). The prior art recognized that, although one could use "optical amplifiers" to "amplify optical signals and compensate loss," "the amplify the entire WDM signal and their gain spectrum is typically not flat[,]" which would motivate a person of ordinary skill in the art to combine or modify the prior art to "maintain the power levels of different signals", including to maintain them such that they are "the same or at least in predetermined ratios." *See, e.g.*, *Smith* at 6:18–23. The prior art also recognized the importance of dynamically controlling power levels and implementing feedback control to, for example, "maintain a significant degree of uniformity of power levels across the WDM spectrum," and to account for "internal variations of optical characteristics and misalignments" and "mechanical stress," (*see, e.g.*, *id.* at 6:24–50; *see also, e.g.*, *Rose* at 11:37–41), and a person of ordinary skill in the art would have been motivated to combine or modify the prior art to implement feedback control to control power levels and to dynamically control power levels. The prior art also recognized the importance of monitoring "the power levels for the individual WDM wavelength channels" and/or [i]nput power" "for each wavelength channel" in dynamically controlling power levels and implementing feedback control (*see, e.g.*, *Smith* at 7:25–30; *see also, e.g.*, *Carr* at 11:11–12:50), and a person of ordinary skill would have been motivated to combine or modify the prior art to do so in order to dynamically

control power levels and implement feedback control. The prior art also recognized that power levels could be adjusted by, for example, (1) the number of mirrors used, (2) the angle of the mirrors, and (3) the location of the mirrors (*Tew '070*, ¶ 37; *see also, e.g.*, *Smith* at 6:55–57, 7:32–44, 7:49–52; *Carr* at 11:11–12:50), and a person of ordinary skill in the art would have been motivated to combine or modify the prior art to use any or all of these techniques. The prior art also recognized that the angle of the mirrors was particularly important when the mirrors were operated in an analog mode, as opposed to a digital mode. *See, e.g.*, *Tew '070*, ¶ 37. A person of ordinary skill would have been motivated to combine or modify prior art disclosures of micromirror arrays to adjust for power levels (to the extent adjusting for power levels was not already taught or accounted for by a prior art disclosure). The prior art also recognized that adjusting power levels could be accomplished by monitoring signal strength, and that the monitoring could be accomplished by internal or external sources (*see, e.g.*, *id.*, ¶¶ 45–46; *see also, e.g.*, *Smith* at 13:39–55). The prior art also recognized that it was "desirable to integrate" into optical networks systems that utilized arrays of mirrors (or beam deflecting elements) that were tiltable about two axes, at least so as to dynamically control power levels. *See, e.g.*, *Smith* at 6:51–61 (describing U.S. Patent No. 6,263,123 to Bishop et al.). A person of ordinary skill in the art would have not only been motivated to combine or modify the prior art so as to dynamically control power levels and implement feedback control but would have been specifically been motivated to combine or modify the prior art to incorporate arrays of mirrors tiltable about two axes to do so. The prior art also recognized that one particularly desirable way of monitoring power levels was to "monitor the intensities of WDM channels" "with the main emphasis on determining the ratio of signal to noise (*see, e.g.*, *Smith* at 6:61–67 (citing U.S. Patent No. 4,796,479 to Derickson et al.); *see also, e.g.*, *Sparks* at 1:11–25), and a person of ordinary skill would have been motivated

to combine or modify the prior art to monitor signal intensities and determine signal-to-noise ratios in the process of performing dynamic power control and feedback control. The prior art also recognized "several criteria for adjusting relative power between channels," including, for example, matching intensity between channels and pre-emphasizing certain intensities of channels (*see, e.g.*, *Smith* at 9:58–10:12), and a person of ordinary skill in the art would have been motivated to combine or modify the prior art to incorporate such criteria in the process of performing dynamic power control and feedback control. The prior art also recognized that feedback control and dynamic power control did not require "the use of free-space optics . . . for the dispersion, the switching, or the power adjustment" (*see, e.g.*, *id.* at 19:56–59), and a person of ordinary skill in the art would have been motivated to modify or combine prior art disclosures both utilizing and not utilizing free-space optics to implement feedback control and dynamic power control. The prior art also recognized that "each of the channels passing through [a] switch may be attenuated to whatever degree necessary to achieve the desired effect, e.g., equalization of optical power across all channels" (*see, e.g.*, *Sparks* at 2:33–36), and a person of ordinary skill in the art would have been motivated to combine or modify prior art disclosures involving feedback control or dynamic power control to achieve any desired effect, including, for example, equalization across all or a subgroup of channels. The prior art also taught that, at least in certain circumstances, it was advantageous to use feedback control or dynamic power control to "provide a predetermined optical output power" (*see, e.g.*, *Sparks* at 3:38–44) or "a predetermined ratio of output optical power between at least any two of said different wavelength optical signals" (*id.* at 3:4–9), and a person of ordinary skill would have been motivated to combine or modify prior art disclosures involving feedback control or dynamic power control to maintain a predetermined power or a predetermined power ratio compared to other optical signals.

As another example, the prior art also recognized that "a fundamental control mechanism" of "optical switches based on tilting mirrors is the degree of coupling" between components (*see, e.g.*, *Smith* at 16:53–65), and a person of ordinary skill would have been motivated to combine or modify the prior art to monitor the degree of coupling (or, for example, a coupling efficiency) between components and to performing feedback control and dynamically control power levels based on the degree of coupling (or, for example, a coupling efficiency) or to adjust a degree of coupling (or, for example, a coupling efficiency), such as to achieve or maintain a desired degree of coupling (or, for example, a coupling efficiency). The prior art also recognized "two principal types of alignment or mismatch," namely, "positional mismatch" or "angular mismatch" (*see, e.g.*, *id.* at 17:24–52), and a person of ordinary skill in the art would have been motivated to combine or modify the prior art to either account for this alignment or mismatch or to intentionally use this alignment or mismatch (*see, e.g.*, *id.* at 18:54–57; *see also, e.g.*, *Carr* at 12:1–5; *Sparks*, Abstract) to, for example, implement dynamic feedback control or dynamically control power levels. The prior art also recognized the distinction between "power tuning or equalization" and "calibration tuning" (*see, e.g.*, *Smith* at 18:32–41), and a person of ordinary skill in the art would have been motivated to combine or modify the prior art to not only utilize feedback control and dynamic power control, but to use such control for power tuning or equalization and/or calibration tuning (or, for example, to modify disclosures feedback control dynamic power control focused on power tuning or equalization to focus on calibration tuning, and vice-versa).

As another example, the prior art recognized that, while circulators could be used in various systems, they could be replaced by, for example, "[a]ny light separation device[.]" *See, e.g.*, *Tew '070*, ¶ 39. Such a light separation device included "a diffraction grating, prism, or other optical component." *See, e.g.*, *id.*, ¶ 40. The prior art also recognized that circulators were "bulky" and

"costly." *See, e.g.*, *Bouevitch* at 13:5–6; U.S. Patent No. 5,960,133 at 4:3-4 ("Circulators are expensive and add loss.") *See also, e.g., Kramer* at 33:56-34:2 and 34:20-28. Accordingly, a person of ordinary skill in the art would have been motivated to combine or modify prior art disclosures to replace or eliminate circulators and, if necessary, replace them with more ideal components such as, for example, other light separation devices.

As another example, the prior art recognized that any number of "fabrication processes" could be used to create MEMs micromirrors that could be used even if they resulted in "somewhat different structures" (*see, e.g.*, *Smith* at 14:65–15:5) because it would not impact the operation of the overarching method, apparatus, or system. A person of ordinary skill would have been motivated to combine or modify the prior art even if disclosed MEMs micromirrors were somehow different or had different structures.

As another example, to the extent various pieces of prior art directly referred to one another, a person of ordinary skill in the art would have been motivated to combine or modify those prior art references, or to combine or modify references with similar disclosures. *E.g., Smith* at 3:66-4:24 (referencing *Solgaard*).

As another example, to the extent various pieces of prior art shared a named inventor or shared an assignee, a person of ordinary skill in the art would have been motivated to combine or modify those prior art references, or to combine or modify references with similar disclosures.

3. <u>The Knowledge of Persons of Ordinary Skill in the Art</u>

As another example, a person of ordinary skill in the art would have been motivated to combine or modify any of the disclosed prior art ((including to form the specific exemplary combinations identified above in Section III.A) because it was within such person's knowledge to combine or modify the prior art to include various features omitted from any single prior art reference or combination of references. Such features include, but are not limited to, the following:

- Optical add-drop apparatuses and methods of performing dynamic add and drop in WDM optical networks;
- Wavelength-separating-routing apparatuses, including auxiliary wavelength-separating-routing apparatuses;
- Receiving a multi-wavelength optical signal;
- Fiber collimator ports or fiber collimators serving as ports, including but not limited to fiber collimator input, output, add, drop, and pass-through ports;
- One- or two-dimensional arrays of ports, including fiber collimator ports or fiber collimators serving as ports;
- Wavelength-selective devices or wavelength separators for spatially separating spectral channels, including but not limited to (1) ruled diffraction gratings, (2) holographic diffraction gratings, (3) echelle gratings, (4) curved diffraction gratings, (5) dispersing prisms, and (6) dispersing gratings;
- Beam-deflecting elements or channel micromirrors, including beam-deflecting elements or channel micromirrors that (1) each receive a corresponding spectral channel, (2) are individually controllable, (3) are continuously controllable, (4) are dynamically controllable (5) are controllable in two dimensions; (6) are pivotable about two axes; (7) reflect a spectral channel to different ports, such as output ports, drop ports, pass-through ports, or exiting ports; and/or (8) control the power of a corresponding spectral channel;
- Spatial arrays of beam-deflecting elements or channel micromirrors, including special arrays of beam-deflecting elements or channel micromirrors that reflect

subsets of certain spectral channels to certain ports, as output ports, drop ports, pass-through ports, or exiting ports;

- Imaging spectral channels onto beam-deflecting elements or channel micromirrors;
- Focusing spectral channels onto beam-deflecting elements or channel micromirrors;
- Control units for beam-deflecting elements or channel micromirrors, including control units that cause beam-deflecting elements or channel micromirrors to direct spectral channels to certain ports and/or to control power levels;
- Servo-control assemblies;
- Spectral monitors, including spectral monitors for monitoring power levels of spectral channels, and other methods of and devices for monitoring power levels of spectral channels;
- Processing units for controlling beam-deflecting elements or channel micromirrors, including processing units responsive to power levels;
- Servo-control assemblies (or other assemblies or devices) or feedback controls, including servo-control assemblies or feedback controls that (1) maintain power levels at predetermined values, (2) provide control for beam-deflecting elements or channel micromirrors, (3) maintain a predetermined coupling efficiency for all and/or certain spectral channels, including spectral channels being directed to a certain port, (4) maintain a predetermined coupling for all and/or certain spectral channels, including spectral channels being directed to a certain port, (5) monitor power levels of all and/or certain spectral channels, including spectral channels

being directed to a certain port, (6) include a spectral monitor, and/or (7) include a processing unit.

- Alignment mirrors or collimator-alignment mirrors, including alignment mirrors or collimator-alignment mirrors that (1) are in optical communication with a wavelength-separator and one or more certain ports and/or (2) adjust alignment of, input signals, output signals, and/or individual spectral channels or groups of spectral channels, and/or (3) direct reflected spectral channels into certain ports, such as output ports, drop ports, pass-through ports, or exiting ports;
- Arrays of alignment mirrors or collimator-alignment mirrors, including one-dimensional arrays;
- Combining or multiplexing spectral channels to form a multi-wavelength optical signal;
- Beam-focusers for focusing separated spectral channels onto beam deflecting elements or channel micromirrors, including (1) beam-focusers comprising a focusing lens having first and second focal points and/or (2) beam-focusers comprising one or more or an assembly of lenses;
- Placing a wavelength-separating apparatus or wavelength-separator at a first focal point of a focusing lens, and placing beam-deflecting elements or channel micromirrors at a second focal point of a focusing lens;
- Micromachined mirrors, including silicon micromachined mirrors;
- Micromirrors;
- Not using or otherwise passing certain signals or spectral channels through circulators;

- Power-management systems, including power-management systems configured to (1) manage power levels of certain spectral channels and/or (2) control coupling efficiency between spectral channels and ports;
- Controlling an alignment between an input multi-wavelength optical signal and corresponding beam deflecting elements based on monitoring power levels for certain spectral channels;
- Beam-focusers, including beam-focusers for focusing spectral channels onto corresponding spectral spots;
- Quarter-wave plates, including quarter-wave plates optically interposed between wavelength-selective devices or wavelength separators and beam-deflecting elements or channel micromirrors; and
- Optical sensors, including optical sensors optically coupled to one or more certain ports, including drop ports, output ports, pass-through ports, or exiting ports.

4. The Predictable Results Obtained in Combining the Different Elements of the Prior Art According to Known Methods

As another example, a person of ordinary skill in the art would have been motivated to form combinations based on any of the disclosed prior art to include features omitted from any single prior art reference or combination of references because doing so would have generated predictable results and could have been accomplished according to known methods. Such features include, but are not limited to, the each of the features identified in Section III.B.3., above.

5. The Predictable Results Obtained in Simple Substitution of One Known Element for Another

As another example, a person of ordinary skill in the art would have been motivated to combine or modify the prior art (including to form the specific exemplary combinations identified

above in Section III.A) because doing so would have involved substituting one feature for another feature known in the art and would have generated predictable results. Such features that could have been added by substitution include, but are not limited to, each of the features identified in Section III.B.3., above.

6. The Use of a Known Technique to Improve Similar Devices, Methods, or Products in the Same Way

As another example, a person of ordinary skill in the art would have been motivated to combine or modify the prior art (including to form the specific exemplary combinations identified above in Section III.A), because doing so would have used known features to improve similar devices, methods, or products (including but not limited to devices, methods, or products in or related to the field of optical switching) in the same way, and would have generated predictable results. Such features include, but are not limited to, the each of the features identified in Section III.B.3., above.

7. The Predictable Results Obtained in Applying a Known Technique to a Known Device, Method, or Product Ready for Improvement

As another example, a person of ordinary skill in the art would have been motivated to combine or modify the prior art (including to form the specific exemplary combinations identified above in Section III.A), because doing so would have involved applying a known technique to improve a known device, method, or product (including but not limited to devices, methods, or products in or related to the field of optics or optical switching), and would have generated predictable results. Such features include, but are not limited to, the each of the features identified in Section III.B.3., above.

8. The Finite Number of Identified Predictable Solutions that Had a Reasonable Expectation of Success

As another example, a person of ordinary skill in the art would have been motivated to combine or modify the prior art (including to form the specific exemplary combinations identified above in Section III.A) because doing so would have been obvious to try. Specifically, a person of ordinary skill in the art would have recognized that, within the field of optics or optical switching (for example), there were a finite number of identified, predictable potential features that could solve a recognized need or problem, and a person of ordinary skill in the art would have pursued incorporating these known features with a reasonable expectation of success. Such features include, but are not limited to, the each of the features identified in Section III.B.3., above.

9. Known Work in Various Technological Fields that Could Be Applied to the Same or Different Technological Fields Based on Design Incentives or Other Market Forces

As another example, a person of ordinary skill in the art would have been motivated to combine or modify the prior art (including to form the specific exemplary combinations identified above in Section III.A), including the prior art references, which are in the same field of the Asserted Patents and each other (such as optics or optical switching, including for multi-wavelength WDM communications), or in a different field, to include various features because doing so would have been prompted by design incentives or market forces, variations or principles applying such features that were known in the prior art, and doing so would have generated predictable results. Such design incentives or market forces included but were not limited to those identified by the Asserted Patents themselves and the prior art (discussed above in Sections III.B.1–III.B.8). Such features include, but are not limited to, the each of the features identified in Section III.B.3., above.

10. Previously Identified Motivations to Combine

As another example, Capella has been put on notice of other motivations to combine, via previously served invalidity contentions (*see, e.g.*, Defendants Fujitsu Network Communications, Inc.'s Preliminary Invalidity Contentions, *Capella Photonics, Inc. v. Fujitsu Network Communications, Inc.*, Case No.: 1:14-CV-20531-PAS (S.D. Fla. May 19, 2014) (Dkt. No. 49) and via *inter partes* review proceedings before the Patent Trial and Appeal Board (*see, e.g.*, *Cisco Sys., Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2014-01166 (PTAB July 15, 2014); *Cisco Sys., Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,678, IPR2014-01276 (PTAB Aug. 12, 2014); *Fujitsu Network Comm'ns, Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2015-00726 (PTAB Feb. 12, 2015); *Fujitsu Network Comm'ns, Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,678, IPR2015-00727 (PTAB Feb. 12, 2015); *JDS Uniphase Corp. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2015-00731 (PTAB Feb. 13, 2015); *JDS Uniphase Corp. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,678, IPR2015-00739 (PTAB Feb. 14, 2015); *Ciena Corp. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2015-00816 (PTAB Feb. 26, 2015); *Ciena Corp. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,678, IPR2015-00894 (PTAB Mar. 17, 2015); *Ciena Corp. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2015-01958 (PTAB Sep. 24, 2015); *Ciena Corp. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,678, IPR2015-01961 (PTAB Sep. 24, 2015); *Coriant Operations, Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2015-01969 (PTAB

Sep. 25, 2015); *Coriant Operations, Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,678, IPR2015-01971 (PTAB Sep. 25, 2015)). At least some of these motivations to combine are identical to or fall within the motivations to combine already identified above. FNC contends that these previously identified motivations to combine with respect to the '368 and '678 Patents are also applicable to the Asserted Patents for at least the prior art identified in these Contentions and the specific combinations identified above in Section III.A, to the extent the prior art contains the same or similar features as those identified in the discussions of the specific prior art references below.

a. Use of 2-Axis Mirrors, Both for Switching and Power Control

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to use 2-axis mirror for switching and power control for at least the following reasons stated in previously served invalidity contentions:

> The use of MEMS technology in fiber-optic components for equalization and switching was well known by 1999. E.g., U.S. Patent No. 5,745,271; U.S. Patent No. 6,097,859. For example, an early use of MEMS technology for optics was the Texas Instruments (TI) Deformable Mirror Device (DMD) (also known as the Digital Mirror Device). The basic technology was developed in the 1980s, and had reached volume production in the early 1990s for projection displays called Digital Light Projectors (DLP). The TI Optical MEMS display used a silicon chip covered with tiny mirrors that could be electrically controlled and rotated. See U.S. Patent Application Publication No. 2002/0081070. With the drive toward more efficient MEMS devices (including ROADMs), certain investigators had come to understand the limitations of 1-axis MEMS mirrors and that 2-axis MEMS mirrors could help to overcome such limitations.
>
> Thus, the very motivation that drove the development of 2-axis MEMS mirrors in the first instance, is the motivation to use 2-axis MEMS mirrors in applications where 1-axis mirrors were previously used. Some prior art references cited above disclose 1-axis MEMS mirrors, others disclose 2-axis MEMS mirrors, while others disclose both 1 and 2-axis MEMS mirrors. A person of ordinary skill in the art would have been motivated to combine the references disclosing

1-axis mirrors with those disclosing 2-axis mirrors to enhance the systems disclosed in the 1-axis mirror references to include a 2-axis mirror. Both the 1 and 2-axis mirror references disclose mirrors which are rotatable to direct a wavelength of light (or wavelength channel) to a specific location; for example, to an output port in order to perform a switching function in an optical network element.

It would have been obvious to someone skilled in the art to replace a disclosed 1-axis MEMS mirror with a 2-axis MEMS mirror from another reference as a matter of common sense and routine innovation and would be merely the application of known elements to achieve predictable results, with a reasonable expectation of success.

For example, at the time of the invention of the Patents-in-Suit, it was known in the art that it was advantageous in optical switching systems to equalize the output power of all wavelength channels. *E.g.*, U.S. Patent Application No. 601234,683, p. 11. It was also known in the art that the optical throughput of each wavelength channel could be controlled by using a MEMS mirror (or mirror array) that could be rotated about two axes. *Id.* at 6. For example, rotation about a first axis could be used to perform switching functions, such as optical cross-connections (directing a wavelength channel to a specific output port), while rotation about a second axis could be used for power control. *Id.* It was also known in the art that both the switching functions and power control could be accomplished using 1-axis MEMS mirrors, but that compared to 2-axis MEMS mirror systems, 1-axis MEMS mirror systems suffer from increased potential for crosstalk between channels. *Id.* at 11. Accordingly, at the time of the alleged invention, it would have been obvious to those skilled in the art to utilize 2-axis MEMS mirrors in optical switching systems disclosing only 1-axis MEMS mirrors, in order to enable power control while minimizing cross talk. *Id.* at 10 ("2-axis MEMS arrays may be used to control the output of prior art switches. For example, they may be used to add output power control capability to the prior art designs disclosed in *Tomlinson* and *Solgaard*.").

As another example, at the time of the invention of the Patents-in-Suit, a typical requirement of optical cross-connects was that any input be capable of being connected to any output. U.S. Patent No. 6,798,992, col. 2, ll. 55-56. Output ports can be configured in 1 or 2-dimensional arrays. In at least some systems, 2-dimensional ("2-D") arrays are preferable. *Id.* at col. 3, ll. 17-22. When output ports are configured in a 2-dimensional array, it would be desirable to use an array of 2-axis MEMS mirrors so that each wavelength channel reflected by a 2-axis MEMS mirror could be directed to any of the

> output ports in the 2-dimensional array. Accordingly, at the time of the invention, it would have been obvious to those skilled in the art to utilize 2-axis MEMS mirrors in optical switching systems in order to utilize output ports configured in a preferable 2-dimensional array
>
> Those skilled in the art would also be motivated to substitute 1-axis MEMS mirrors with 2-axis MEMS mirrors because of increased port density through 2-D arrays, reduced crosstalk, and ability to reduce device size through 2-D arrays. In addition to the common sense of the person skilled in the art, such motivations for the combination are found in the prior art, such as: U.S. Patent No, 6,798,941, col. 16, ll. 55-59, col. 18, ll. 18-25; and U.S. Patent No. 6,253,001, col. 2, ll. 1-16.
>
> Moreover, as there are only limited available options to try —1 or 2 axis mirrors —the substitution of 1-axis mirrors with 2-axis mirrors would have been obvious to try. Given these reasons, it would have been obvious to use 2-axis deflecting elements….

Defendants Coriant (USA), Inc.'s and Columbus Networks USA, Inc.'s Preliminary Invalidity Contentions, *Capella Photonics, Inc. v. Tellabs, Inc.,* No. 14-CIV-60350 (S.D. Fla. June 16, 2014) (Dkt. No. 62) at 21–24.

b. Continuous (Analog) Mirror Control

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to have continuous analog mirror control for at least the following reasons stated in previously served invalidity contentions:

> Rotating MEMS mirrors by continuous analog control in fiber-optic systems was well known by 1999. For example, an application to Smith discloses "the optical throughput of each wavelength channel may be controlled by using a mirror array with elements that can be rotated in an analog fashion about two orthogonal axes" (U.S. Patent App. 60/234,683, p. 6); an application to Heanue described "... a optical switching module 100 that were first made in March 1999, using 2D mirror surfaces 116 whose orientations were controlled by analog dual axis servo controllers" (U.S. Patent App. 2003/0223726, ¶ 48); a patent to Bishop disclosed "[a] typical requirement of optical crossconnects is that any input be capable of being connected to any output.... Each mirror „.is capable of operatively rotating or tilting about orthogonal X-Y axes, with the tilt angle being selectively determined by the amount of voltage applied to the

> control electrodes" (U.S. Patent No. 6,798,992, col. 2, ll. 55-65); a patent to Riza disclosed that "attenuation control in these modules is implemented in an analog fashion by carefully moving a micromirror per beam (or wavelength) through a continuous range of positions" (U.S. Patent No. 6,222,954, col. 2, ll. 23-26)
>
> It would have been obvious to someone skilled in the art to incorporate the continuous mirror control features of the prior art with other optical switching devices as a matter of common sense and routine innovation. Also, such a combination would be merely the application of known elements to achieve predictable results, with a reasonable expectation of success.
>
> Analog control allows for more flexibility in the rotation of a MEMS mirror, along withgreater precision, providing improved power/attenuation control and switching capability. (See, e.g., U.S. Patent No. 6,798,992, col. 2, ll. 55-65; U.S. Patent No. 6,222,954, col, 2, ll. 23-26). A person skilled in the art would have been motivated to incorporate the continuous mirror control features of the prior art with other optical switching devices in order to have greater precision and rotation flexibility in a MEMS mirror (for example, to direct a wavelength channel to any output port as suggested by, e.g., U,S. Patent No. 6,798,992, col. 2, ll. 55-56). Additionally, a person skilled in the art would be motivated to use the known continuous mirror control features of the prior art to improve similar devices, such as the devices disclosed in U.S. Patent No. 6,507,421, col. 3, l. 10-11, and U.S. Patent No. 6,253,001, col. 1, l. 65 to col. 2, l. 13.
>
> Moreover, the substitution of discretely controlled mirrors with continuously controlled mirrors would have been obvious to try. (See, e.g., U.S. Patent No. 5,661,591,col. 2, ll. 7-9, col. 3, ll. 41-57).
>
> The prior art also suggests such a combination. For example, a patent to Lin discloses that a discretely movable mirror may optionally be continuously controlled for enhanced functionality. (U.S. Patent No, 5,661,591, col. 2, ll. 7-9, col. 3, 11, 41-57; see also, U.S. Patent App. 60/234,683, p. 6, Fig. 11).

Id. at 24–26.

c. Power Control By Mirror Misalignment

A person of ordinary skill in the art would have been motivated to combine or modify the prior art for power control by mirror misalignment for at least the following reasons stated in previously served invalidity contentions:

> To the extent that any of the prior art references do not explicitly or inherently disclose misalignment of MEMs mirrors for power control and attenuation, a person of ordinary skill in the art would have been motivated to add that to any of the prior art references that disclose MEMs mirrors, for the purpose of controlling signal power. The use of two-axis tiltable MEMS mirrors in fiber-optic components for power control and attenuation was already well known by 1999. See, e.g., U.S. Patent No. 6,798,941 ("Smith") at 16:34-51,16:55-58, 17:53-18:25, Fig. 9; U.S. Patent No. 6,961,506 ("Neukermans") at Fig. 3a, 5:15-19,5:53-64; Bouevitch at 1:18-25; 1:50-61; 7:34-37; U.S. Patent No. 6,519,075 ("Carr") at 13:47-62; 14:22-29; U.S. Patent No. 6,625,340 ("Sparks") at 2:20-25; 5:1-11; Fig. 2b.
>
> The benefits of using tiltable MEMS mirrors for power control and attenuation were also clear. For example, with such power control, it was possible for ROADMs and cross-connects to achieve power equalization in which the power levels of different wavelength channels are adjusted to conform to a standardized non-flat spectrum for downstream devices. See, e.g., Smith at 10:10-13. Smith further explains that such power equalization is desired in order to, for example, satisfy the dynamic range restrictions of downstream receivers, or satisfy the amplifier input limits of downstream receivers. Smith at 10:47-55. Further, Neukermans explains that it is "highly desirable" to control power of different spectral channels at a common, predetermined power value because otherwise, if they are "multiplexed together without controlling their respective strengths, wavelengths having different strength may increase differently during subsequent optical amplification." Neukermans at 2:60-3:7. In addition, the use of 2-axis tiltable mirrors for signal misalignment was preferred as the non-switching axis can be used to control power and minimize cross talk. Smith at 18:15-21. Further, many references, such as Smith and U.S. Patent No. 6,798,992 ("Bishop") recognized the problem that optical switches are susceptible to "drift" due to environmental conditions, such as temperature changes, and manufacturing variations. Bishop at 3:54-58; see also Smith at 10:22-23; 17:53-18:11. By controlling power through the misalignment of MEMs mirrors, one of ordinary skill in the art could solve such "drift" problems.

Given these reasons, it would have been obvious to a person of ordinary skill in the- art to have combined the known method of misaligning MEMs mirrors to control power …, with other references …, to achieve predictable results and benefits with a reasonable expectation of success. For example, many [] references taught the use of tilting 2D mirrors in NxN cross-connects to control power. Some of these references include U.S. Patent Publication Nos. 2003/0223726 and 2002/0092963, and the following U.S. Patents {collectively, the "Known NxN Cross-Connects")

6,798,941;
6,507,421;
6,798,992;
6,480,645;
6,442,307;
6,519,075;
6,567,574;
6,989,921;
6,792,174;
6,668,108;
6,697,547;
6,253,001;
6,778,739

It would have been obvious to someone skilled in the art to incorporate the 2D mirror tilting and power control functionality of the Known NxN Cross-Connects with another NxN fiber optic component …, such as Patent No. 6,097,859 ("Solgaard"), Solgaard discloses an NxN wavelength selective cross-connect with multiple input ports and output ports. Solgaard also teaches that an input signal is separated by a grating device and each wavelength is impinged upon a mirror in a tiltable micromirror array where each wavelength channel can be routed to any output port. Solgaard further discloses a spectral monitor that reports signal power to the control unit. One of ordinary skill would have been motivated to modify Solgaard's NxN cross-connect and its tiltable mirrors in view of the Known NxN Cross-Connects to achieve power control by mirror mis-alignment for several reasons. First, both the Solgaard crossconnect and any one of the Known NxN Cross-Connects are conceptually similar and compatible in that they both disclose a cross connect with multiple input ports and multiple output ports. Moreover, the control unit disclosed in Solgaard receives reported power, so it would have been obvious for a person of ordinary skill in the art to modify it in order to also control or attenuate power by deliberate misalignment as disclosed in the Known NxN Cross-Connects to achieve the associated benefits.

> As another example, one of ordinary skill in the art would have found it obvious to incorporate the 2D mirror tilting and power control functionality of the Known NxN CrossConnects with ROADM references such as Bouevitch. Bouevitch already contemplates power control by adjusting the angle of deflection, Bouevitch at 7:34-37. References such as Smith discuss the benefits of using 2D tiltable mirrors for power control, such as minimizing cross talk, Thus, one of ordinary skill would have been motivated to incorporate 2D tiltable mirrors, such as those from Smith, into ROADM references, such as Bouevitch, to implement power control.

Id. at 26–29.

d. Control Unit

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include a control unit for at least the following reasons stated in previously served invalidity contentions:

> To the extent that any of the prior art references do not explicitly or inherently disclose a control unit for controlling beam-deflecting elements such as micromirrors, a person of ordinary skill in the art would have been motivated to add a control unit to any of the prior art references that disclose one or more beam-deflecting elements, for the purpose of controlling those beam-deflecting elements. Without such a control unit, the beam-deflecting elements would not be adjustable, and thus most, if not all, devices incorporating the beam-deflecting elements would fail to function properly. For instance, without a control unit to control the beam-deflecting elements in an optical switch device such as a ROADM or optical cross-connect, the optical switching device would be incapable of changing the switch configuration between the input port(s) and the output port(s). Thus, including a control unit is not only desirable, it is essential to the operation of such devices.
>
> It would also have been obvious to a person of ordinary skill in the art to have combined prior art elements, such as known control units, according to known methods to yield predictable results with a reasonable expectation of success. In fact, it was already known, at the time of the invention, to control micromirror arrays and other beam-deflecting elements to achieve reconfigurable optical switching and dynamic optical power control. Indeed, the Patents-in-Suit themselves acknowledge that such functionality was well-

known and easy for one of ordinary skill to implement at the time of the invention.

> The electronic circuitry and the associated signal processing algorithm/software for such processing unit in a servo-control system are known in the art. A skilled artisan will know how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application.

('368 patent, col. 12, ll. 9-15; '678 patent, col. 12, ll. 9-15). Consistent with the inventors' admissions, the prior-art references … teach control units comprising power monitors for monitoring of power levels of optical channels and processing units that, based on the power levels, controlled switching devices of the optical channels for various reasons. Such reasons include maximizing optical coupling/power transfer, equalizing optical power across multiple spectral channels, and controlling power of an optical channel to specific levels….

As discussed herein in section II(c)(iii)(a), the use of tiltable MEMS mirrors in fiber-optic components for power control and attenuation was well known. It was also well known prior to the effective filing date of the Patents-in-Suit to use a control unit to control those mirrors (e.g., U.S. Patent No. 6,097,859 ("Solgaard")) and as a means for feedback control of the MEMS mirrors to control power through mirror misalignment.

For example, U.S. Patent No. 6,697,547 to Walter et al, discloses a switch matrix 30 (fig. 2) used in a dense wave division multiplexing (DWDM) optical network (col. 4 lines 45-52), in which a control unit having a spectral monitor 136 measures the optical power (fig. 10 step 1003) of each spectral output channel signal (fig. 4(a), 4(b), 5) Rom the switch matrix 30, and selectively positions channel reflecting elements in one or two axes based on the power measurements (Fig. 10 step 1015,Fig. 11, col. 11 lines 28-65).

As another example, U.S. Pat. Pub No. 2002/0092963 to Domash et al. discloses a control unit for steering beams with a MEMS mirror between optical ports (see paras. 0035-0043, 0047-0058)

As a further example, G. J. Su et al., MEMS 2D Scanning Mirror for Dynamic Alignment in Optical Interconnect, discloses controlling movement of a two-axis MEMS mirror to correct misalignment (i.e., coupling of an optical beam power between two ports) in a free space optical interconnect (see pp. 180-182) ("G.J.Su").

As yet another example, U.S. Patent No. 6,798,941 to Smith, et al. ("Smith") discloses a control unit that adjusts the tilt positions of micromirrors in a MEMS array. (Smith, Fig. 8 controller 158, Figs. 9 and 11-13controller 220, col. 9, ll. 20-25, col. 13, ll. 21-24, col. 18, ll. 42-53). The control units 158 and 220 control the micromirrors not only to direct beams to selected output ports, but also to control the power coupled into the output ports by offsetting the beams from the output ports in accordance with feedback from monitored optical power. (Smith, col. 9, l. 29 to col. 10, l. 113, col. 13, l. 51 to col. 14, l. 15). It would have been obvious to a person of ordinary skill in the art to have combined the disclosed control units of Smith with any of the MEMS arrays or other beam-deflecting elements disclosed in the prior art references, in the same manner as Smith and to yield the same known result as Smith —to allow for tilt control of the MEMS arrays or other beam-deflecting elements.

Still further examples are U.S. Publication No. 2002/0081070 to Tew (Figs. 4, 6, and 8 controller 328, and Fig. 9 controller 902), U.S. Publication No. 2003/0223726 to Heanue (¶ 48, describing 2D mirror surfaces 116 whose orientations are controlled by analog dual axis servo controllers), and U.S. Patent No; 6,519,075 to Carr, et al. (Fig. 13, feedback system 139)…. For example, combining such references would have been nothing more than using known techniques of mirror control, spectral monitoring, feedback, and control processing in optical interconnects to provide a control unit…. For example, it would have been obvious to combine each of the optical interconnects disclosed …with …Walter, Domash, and G. J. Su, to utilize their control units to improve the performance of the systems by maximizing optical signal power coupling, equalizing spectral channels, correcting misalignment in optical interconnects, or even just to make the controllable mirrors functional. As a second reason to combine the references, the components used …, i.e., MEMS mirrors, optical ports, lens, and servo control of the mirrors for performing the functions of mirror control are the same or analogous to the components … for channel switching functions. It would have been obvious for a person of ordinary skill in the art to try to use these common components for both the functions of optical channel switching and for power control, as there would have been a reasonable expectation of success and a common sense advantage in reducing cost and size of the system by reducing the number of components needed to perform both functions.

Id. at 29–33.

e. Servo Control Assembly

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include a servo-control assembly for at least the following reasons stated in previously served invalidity contentions:

> To the extent that any of the prior art references do not explicitly or inherently disclose such a servo-control assembly, a person of ordinary skill in the art would have been motivated to add a servo assembly to any of the prior art references that disclose one or more beam-deflecting elements, for the purpose of using feedback power measurements to control the beam-deflecting elements. It is well-recognized in the prior art, such as discussed below, to provide optical feedback control of micromirrors and other beam-deflecting elements in an optical switching device such as a ROADM or optical cross-connect.
>
> It would also have been obvious to a person of ordinary skill in the art to have combined prior art elements, such as known control units, according to known methods to yield predictable results with a reasonable expectation of success. In fact, it was already known, at the time of the invention, to control micromirror arrays and other beam-deflecting elements using spectral power feedback. In fact, the Patents-in-Suit acknowledge that such functionality was well-known and easy for one of ordinary skill to implement at the time of the invention:
>
>> The electronic circuitry and the associated signal processing algorithm/software for such processing unit in a servo-control system are known in the art. A skilled artisan will know how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application.
>
> ('368 patent, col. 12, 11, 9-15; '678 patent, col. 12, ll. 9-15). Consistent with the inventors' admissions, the prior-art references … teach a servo control assembly for the monitoring of power levels of optical channels and, based on the power levels, controlling switching devices of the optical channels for various reasons. Such reasons include maximizing optical coupling/power transfer, equalizing optical power across multiple spectral channels, and controlling power of an optical channel to specific levels….

As discussed herein in section II(c)(iii)(a), the use of tiltable MEMS mirrors in fiber-optic components for power control and attenuation was well known. It was also well known prior to the effective filing date of the Patents-in-Suit to use power monitoring of spectral channels to monitor the quality of optical signals (e.g., U,S. Patent No. 6,097,859 ("Solgaard")) and as a means for feedback control of the MEMS mirrors to control power through mirror misalignment.

For example, U.S. Patent No. 6,697,547 to Walter et al. discloses a switch matrix 30 (fig. 2) used in a DWDM optical network (col. 4 lines 45-52), in which a servo control assembly having spectral monitor 136 measures the optical power (fig. 10 step 1003) of each spectral output channel signal (fig. 4(a), 4(b), 5) from the switch matrix 30, and selectively maximizes and/or attenuates individual optical channels based on the power measurements (fig. 10 step 1015,fig. 11)by positioning channel reflecting elements in one or two axes (col. 11 lines 28-65).

As another example, Domash discloses the use of a servo control assembly with sensors (figs. 5, 6) that detects two-axis misalignment using a thin-film sensor of an optical beam steered with a MEMS mirror between optical ports, and a feedback system responsive to the sensors for two-axis fine steering of the MEMS mirror to maximize power transfer (see paras. 0035-0043, 0047-0058).

As a further example, G. J, Su et al. discloses the use of a two-axis MEMS mirror and dynamic tracking to correct misalignment (i,e., coupling of an optical beam power between two ports) in a free space optical interconnect (see pp. 180-182).

As yet another example, Smith discloses a servo control assembly that receives output of an optical power monitor (OPM) and readjusts the tilt positions of micromirrors in a MEMS array in accordance with the output. (Smith, Fig. 8 controller 158 in communication with OPM 156, Figs. 9 and 11-13controller 220 in communication with OPM 218, col. 9, ll. 20-28, col. 13, ll. 21-24, col. 18, l. 42 to col. 19, l. 7). The controllers 158 and 220 of the servo control assembly control the micromirrors not only to direct beams to selected output ports, but also to control the power coupled into the output ports by offsetting the beams from the output ports in response to feedback from the OPMs 156 and 218. (Smith, col. 9, l. 29 to col. 10, l. 113,col. 13, l. 51 to col. 14, l. 15).

Still further examples of a servo control assembly are disclosed in U.S. Publication No. 2002/0081070 to Tew (Figs. 4, 6, and 8, controller 328 in communication with detector 324, and Fig. 9, controller 902 in communication with detector 324), U.S.

> Publication No. 2003/0223726 to Heanue ('I 48, describing 2D mirror surfaces 116 whose orientations are controlled by analog dual axis servo controllers), and U.S, Patent No; 6,519,075 to Carr, et al. (Figs. 12 and 13, feedback system 139).
>
> Each of these above specific examples, the admitted prior art noted above, and []other references…teach a servo control assembly for performing the monitoring, feedback and processing/control features of the claims noted above in the same or analogous optical interconnect and optical switching architectures … in ROADMS and Optical cross-connects….
>
> For one, combining such references would have been nothing more than using known techniques of spectral monitoring, feedback, and control processing in optical interconnects to provide a servo-control assembly … to similar optical interconnects … in the same ways and for the same purposes …. For example, it would have been obvious to combine each of optical interconnects disclosed in Smith, Carr, Tew … with any of …Walter, Domash, and G. J. Su, to improve the performance of the systems by maximizing optical signal power coupling, equalizing spectral channels, and correcting misalignment in optical interconnects.
>
> As a second reason to combine the references, the components used…, i.e., MEMS mirrors, optical ports, lens, and servo control of the mirrors for performing the functions of spectral monitoring and feedback servo control of the mirrors are the same or analogous to the components … for channel switching functions. It would have been obvious for a person of ordinary skill in the art to try to use these common components for both the functions of optical channel switching and for power control in a feedback loop, as there would have been a reasonable expectation of success and a common sense advantage in reducing cost and size of the system by reducing the number of components needed to perform both functions.

Id. at 33–37.

f. Spectral Monitor

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include a spectral monitor for at least the following reasons stated in previously served invalidity contentions:

The use of spectral monitoring and processing for feedback control was not new as of the effective filing date of the Patents-in-suit. Indeed, the inventors admit:

> The processing unit ...typically includes electrical circuits and signal processing programs for processing the power measurements received from the spectral monitor 460 and generating appropriate control signals to be applied to the channel micromirrors 430 ...so to maintain the coupling efficiencies of the spectral channels into the output ports at desired values, The electronic circuitry and the associated signal processing algorithm/software for such processing unit in a servo-control system are known in the art. A skilled artisan will know how to implement a suitable spectral monitor along with an appropriate processing unit to provide a servo-control assembly in a WSP-S apparatus according to the present invention, for a given application.

'368 patent, 12:1-15 (emphasis added). Consistent with the inventors' admissions, the prior-art references identified … teach the monitoring of power levels of optical channels and, based on the power levels, controlling switching devices of the optical channels for various reasons. Such reasons include maximizing optical coupling/power transfer, equalizing optical power across multiple spectral channels, and controlling power of an optical channel to specific levels.

As discussed herein in section II(c)(iii)(a), the use of tiltable MEMS mirrors in fiber-optic components for power control and attenuation was well known. It was also well known prior to the effective filing date of the Patents-in-Suit to use power monitoring of spectral channels to monitor the quality of optical signals (e.g., U.S. Patent No. 6,097,859 ("Solgaard")) and as a means for feedback control of the MEMS mirrors to control power through mirror misalignment.

For example, U.S. Patent No. 6,697,547 to Walter et al. discloses a switch matrix 30 (fig. 2) used in a DWDM optical network (col. 4 lines 45-52), in which a spectral monitor 136 measures the optical power (fig. 10 step 1003) of each spectral output channel signal (fig. 4(a), 4(b), 5) from the switch matrix 30, and selectively maximizes and/or attenuates individual optical channels based on the power measurements (fig. 10 step 1015, fig. 11) by positioning channel reflecting elements in one or two axes (col. 11 lines 28-65).

As another example, Domash discloses the use of sensors (figs. 5, 6) that detects two-axis misalignment using a thin-film sensor of an optical beam steered with a MEMS mirror between optical ports,

and a feedback system responsive to the sensors for two-axis fine steering of the MEMS mirror to maximize power transfer (see paras. 0035-0043, 0047-0058).

As a further example, G. J. Su et al. discloses the use of a two-axis MEMS mirror and dynamic tracking to correct misalignment (*i.e.*, coupling of an optical beam power between two ports) in a free space optical interconnect (see pp. 180-182).

As yet another example, Smith discloses a controller that receives output of an optical power monitor (OPM) and readjusts the tilt positions of micromirrors in a MEMS array in accordance with the output. (Smith, Fig. 8 controller 158 in communication with OPM 156, Figs. 9 and 11-13controller 220 in communication with OPM 218, col. 9, ll. 20-28, col. 13, ll. 21-24, col. 18, l. 42 to col. 19, l. 7). The controllers 158 and 220 control the micromirrors not only to direct beams to selected output ports, but also to control the power coupled into the output ports by offsetting the beams from the output ports in response to feedback from the OPMs 156 and 218. (Smith, col. 9, l. 29 to col. 10, l. 113, col. 13, l. 5 l to col. 14, l. 15).

Still furthers examples are U.S. Publication No. 2002/0081070 to Tew (Figs. 4, 6, and 8, controller 328 in communication with detector 324, and Fig. 9, controller 902 in communication with detector 324), and U.S. Patent No; 6,519,075 to Carr, et al, (Figs. 12 and 13, feedback system 139)

Each of these above specific examples, the admitted poor art noted above, and other references ... teach performing the monitoring, feedback and processing/control features of the claims noted above in the same or analogous optical interconnect and optical switching architectures … in ROADMS and Optical cross-connects….

For example, combining such references would have been nothing more than using known techniques of spectral monitoring, feedback, and control processing in optical interconnects … similar optical interconnects … in the same ways and for the same purposes …. For example, it would have been obvious to combine each of optical interconnects disclosed in Smith, Carr, Tew, … with … Walter, Domash, G. J. Su, to improve the performance of the systems by maximizing optical signal power coupling, equalizing spectral channels, and correcting misalignment in optical interconnects.

As a second reason to combine the references, the components used, *i.e.*, MEMS mirrors, optical ports, lens, servo control of the mirrors for performing the functions of spectral monitoring and feedback servo control of the mirrors are the same or analogous to the

> components in the references … for channel switching functions. It would have been obvious for a person of ordinary skill in the art to try to use these common components for both the functions of optical channel switching and for power control in a feedback loop, as there would have been a reasonable expectation of success and a common sense advantage in reducing cost and size of the system by reducing the number of components needed to perform both functions.

Id. at 37–41.

g. Predetermined Power Values

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include predetermined power levels for at least the following reasons stated in previously served invalidity contentions:

> Maintaining power levels of the spectral channels coupled into the output ports at a predetermined value was well-known in the prior art by 1996. For example, U.S. Patent No. 5,745,271 ("Ford") describes the MARS modulator used for power equalization. Moreover, U.S. Patent No. 6,798,941 ("Smith") discloses that "all wavelength channels on [the] output fiber[s] should have the same intensity so that optical receivers and other components located downstream will detect wavelength channels of equal intensity." Smith at 9;59-63. As another example, U.S. Patent No. 6,961,,506("Neukermans") discloses that "it [is] highly desirable that all wavelengths being multiplexed into a single optical fiber have approximately the same power." Neukermans at 2;60-3:7.
>
> It would have been obvious for someone skilled in the art to maintain power levels of the spectral channels at a predetermined value in a cross-connect or ROADM because of many wellknown benefits conferred. As Smith explains, such power equalization at a predetermined value is desired in order to, for example, satisfy the dynamic range restrictions of downstream receivers and to satisfy the amplifier input limits of downstream receivers. Smith at 10:47-55. And Neukermans explains that it is "highly desirable" to maintain power of different spectral channels at a common, predetermined power value because otherwise, if they are "multiplexed together without controlling their respective strengths, wavelengths having different strength may increase differently during subsequent optical amplification." Neukermans at para. 0011. Further, many references, such as Smith and U.S. Patent No. 6,798,992 ("Bishop") recognized the problem that optical switches

> are susceptible to "drift" due to environmental conditions, such as temperature changes, and manufacturing variations. Bishop at 3:54-58; *see also* Smith at 10:22-23; 17:53-18:11.And it would have been obvious for a person of ordinary skill in the art to use the ability to maintain power levels to solve such "drift" problems. Finally, during the operation of ROADM and crossconnect systems, wavelength channels are constantly being added and removed, which in turn affects power levels of the wavelength channels in transit. U.S. Patent No. 6,442,307 ("Carr") and U.S. Patent No. 5,745,271 ("Ford") both explain that maintaining power levels at a predetermined value solves this problem. Carr at 11:34-52; Ford at 1:58-2:10.
>
> Given these reasons, one of ordinary skill would have found it obvious to include the capability of maintaining spectral channel power levels at a predetermined value when designing ROADMs and crossconnects.

Id. at 41–42.

h. Control Unit Controlling Mirrors to Drop a Channel

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include a control unit controlling mirrors to drop a channel for at least the following reasons stated in previously served invalidity contentions:

> OADMs that implement add/drop channels were not new at the time of the alleged invention and addressed a recognized need in the industry, as conceded by the inventors. For example, the background section of the Patents-in-Suit refers to U.S. Patent Nos. 5,974,207, 6,205,269, 6,204, 946, and 5,9[60],133 as disclosing OADMs that utilize add and drop ports (e.g., '368 patent, col. 1, l. 59 to col. 3, l. 19). There are many other prior-art references that disclose OADMs, and/or optical cross-connects (OXCs) or other switching matrices usable in OADMs, having or otherwise supporting multiple input ports such as one or more add ports and/or multiple output ports such as one or more drop ports….
>
> Some examples of … prior art disclosing OADMs with the capability to add or drop spectral channels, include U.S. Patent No. 6,798,941 ("Smith") at figs. 5-6, col. 10 lines 4-12; U.S. Patent No. 6,097,859 ("Solgaard") at figs. 1-8; and U.S. Patent No. 6,498,872 ("Bouevitch") at fig. 1.

> An example in the … prior art disclosing an OXC used in systems for adding and dropping spectral channels is U.S. Patent No. 6,697,547 to Walter et al., which discloses an OXC 30 (fig. 2) used in a DWDM optical network (col, 4 lines 45-52), that receives spectral channels at any of a plurality of input ports and switches the spectral channels to any of a plurality of output ports (see fig. 4(a), 4(b), 5, 8, col. 8 lines 52-55). Other examples of prior art references including OXCs used in WDM systems for add and drop functions include: U.S. Patent No; 6,519,075 ("Carr") at col. 11 lines 11-52; U.S. Patent No. 6,798,941 ("Smith") at fig. 3 (prior art), 3:22-50; and Paul M. Hagelin et al., Scalable Optical Cross-Connect Switch Using Micromachined Mirrors, IEEE Photonics Technology Letters, Vol. 12, No. 7, 2000.
>
> It would have been obvious to a person of ordinary skill in the art to have combined prior art elements, such as these and other known OXCs, OADMs and other optical switching devices, according to known methods and/or common sense to yield predictable results with a reasonable expectation of success. For example, it would have been obvious to have utilized any of the OXC prior-art references … that support add and/or drop ports in any of the OADM or other optical switching prior-art references … to achieve an OADM that controls a set of mirrors to add an input light beam from an add port and to direct one or more optical channels to a drop port. Combining such references would have involved nothing more than using known techniques of fiber optic coupling and mirror control in optical switching devices. And, because many of these prior-art references … utilize a programmable control unit and/or servocontrol assembly, the control units and/or servo-control assemblies in those prior-art references may be easily reprogrammed in known ways to direct the light beams accordingly. As admitted in the Patents-in-Suit, a skilled artisan would have known how to implement an appropriate processing unit to provide a servo-control assembly in a wavelength-separating-routing apparatus that controls the mirrors for a given application (e.g., '368 patent, col. 12, ll. 11-15). Moreover, combining the prior-art references in this way would have provided an even simpler, more effective, and more economical approach to providing add/drop functionality as compared with the systems allegedly suffering from these problems as described in the background section of the Patents-in-Suit.

Id. at 42–44.

i. Control Unit Controlling Mirrors to Add a Channel

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include a control unit controlling mirrors to add a channel for at least the following reasons stated in previously served invalidity contentions:

> OADMs that implement add/drop channels were not new at the time of the alleged invention and addressed a recognized need in the industry, as conceded by the inventors. For example, the background section of the Patents-in-Suit refers to U.S. Patent Nos. 5,974,207, 6,205,269, 6,204, 946, and 5,9[60],133 as disclosing OADMs that utilize add and drop ports (e.g., '368 patent, col. 1, 1. 59 to col. 3, l. 19). There are many other prior-art references that disclose OADMs, and/or optical cross-connects (OXCs) or other switching matrices usable in OADMs, having or otherwise supporting multiple input ports such as one or more add ports and/or multiple output ports such as one or more drop ports….
>
> Some examples of … prior art disclosing OADMs with the capability to add or drop spectral channels, include U.S. Patent No. 6,798,941 ("Smith") at figs, 5-6, col. 10 lines 4-12; U.S. Patent No. 6,097,859 ("Solgaard") at figs. 1-8; and U.S. Patent No. 6,498,872 ("Bouevitch") at fig. l.
>
> An example in the … prior art disclosing an OXC used in systems for adding and dropping spectral channels is U.S. Patent No. 6,697,547 to Walter et al., which discloses an OXC 30 (fig. 2) used in a DWDM optical network (col. 4 lines 45-52), that receives spectral channels at any of a plurality of input ports and switches the spectral channels to any of a plurality of output ports (see fig. 4{a),4(b), 5, 8, col. 8 lines 52-55). Other examples of prior art references including OXCs used in WDM systems for add and drop functions include: U.S. Patent No; 6,519,075 ("Carr") at col. 11 lines 11-52; U.S, Patent No. 6,798,941 ("Smith") at fig. 3 (prior art), 3:22-50; and Paul M. Hagelin et al., Scalable Optical Cross-Connect Switch Using Micromachined Mirrors, IEEE Photonics Technology Letters, Vol. 12, No. 7, 2000.
>
> It would have been obvious to a person of ordinary skill in the art to have combined prior art elements, such as these and other known OXCs, OADMs and other optical switching devices, according to known methods and/or common sense to yield predictable results with a reasonable expectation of success. For example, it would have been obvious to have utilized any of the OXC prior-art references … that support add and/or drop ports in any of the

> OADM or other optical switching prior-art references … to achieve an OADM that controls a set of mirrors to add an input light beam from an add port and to direct one or more optical channels to a drop port. Combining such references would have involved nothing more than using known techniques of fiber optic coupling and mirror control in optical switching devices. And, because many of these prior-art references … utilize a programmable control unit and/or servo-control assembly, the control units and/or servo-control assemblies in those prior-art references may be easily reprogrammed in known ways to direct the light beams accordingly. As admitted in the Patents-in-Suit, a skilled artisan would have known how to implement an appropriate processing unit to provide a servo-control assembly in a wavelength-separating-routing apparatus that controls the mirrors for a given application (e.g., '368 patent, col. 12, ll. 11-15). Moreover, combining the prior-art references in this way would have provided an even simpler, more effective, and more economical approach to providing add/drop functionality as compared with the systems allegedly suffering from these problems as described in the background section of the Patents-in-Suit.

Id. at 44–46.

j. Use of a "Ruled Diffraction Grating"

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include a ruled diffraction grating for at least the following reasons stated in previously served invalidity contentions:

> To the extent that any of the prior art references do not explicitly or inherently disclose wavelength separation, a person of ordinary skill in the art would have been motivated to add that to any of the prior art references …, for the purpose of wavelength selective routing. Wavelength separation in fiber-optic components for wavelength selective routing was well known by 1999. See, e.g., Bouevitch, Fig. 11, 1:31-50, 14:14-20, 48-55; U.S. Patent No. 6,263,127 at 3:8-41; US 2002/0081070, 0005-0006, 0033-0044; US 5,936,752, 1:55-60, 2:61-3:12,3:49-55;U.S. Patent No. 6,798,941; U.S. Patent No. 6,498,872; U.S. Patent No. 6,097,859 at 3:57-4:1;"Wavelength Add —Drop Switching Using Tilting Micromirrors," by Ford et al. For example, by 1999 and the early 2000s, many references taught the use of diffraction grating for the benefit of separating a multi-wavelength signal into individual wavelength channels so that each channel can be independently processed (e.g. attenuated) and routed. See, e.g., Solgaard '859 patent at 3:57-4:1;Bishop '752 patent

> at 2:61-3:12and 3:49-55; Tew at 0005-0006 and 0033-0044; U.S. Patent No. 6,263,127 ("Dragone") at 3:8-41. In view of this benefit, it would have been obvious for someone skilled in the art to incorporate a diffraction grating module into any of the references …, including the Known NxN Cross-Connects. For example, Dragone discloses two different wavelength separating devices — an array waveguide grating and a diffraction grating —that allow for the demultiplexing of signals to be processed by a 2D mirror array. One of ordinary skill would have been motivated to modify any Known NxN CrossConnects, e.g., U.S. Patent No. 6,442,307 ("Carr"), to include Dragone's wavelength selective routing capability. Carr's cross connect already used a similar 2D mirror array as the core component, so it would have been obvious to include Dragone's wavelength separating device into Carr's system to realize an apparatus with wavelength selective routing and add-drop functionality.

Id. at 46–47.

k. *Using Reflective Membranes as Beam-deflecting Elements*

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to use reflective membranes as beam-deflecting elements for at least the following reasons stated in previously served invalidity contentions:

> To the extent that any of the prior art references do not explicitly or inherently disclose the use of reflective membranes as beam-deflecting elements, it would have been obvious to use such membranes. Reflective membranes were well known at the time of the effective filing date of the Patents-in-Suit, and a person of ordinary skill in the art would have been motivated to use such membranes for beam-deflecting.
>
> Reflective membranes used for switching (e.g., beam deflection) were known to have "wide fabrication tolerance, high speed, wide optical spectrum, and low total packaged cost." (James A, Walker et al., Fabrication of a Mechanical Antireflection Switch for Fiber-to-the-Home Systems, 5 J. Microelectromechanical Sys. 45, 46 (1996) ("Walker").) Membrane switches also had relative advantages over other deflecting elements. In comparison to reflective membranes, "[b]y the very nature of their modulation mechanisms, the deformable light valve and variable Fabry-Perot device suffer from a narrow optical spectrum and high fabrication complexity, which leads to high fabrication cost." (*Id.*)

There are multiple reasons that using membranes was obvious. First, using such membranes was a simple substitution of one known element for another to obtain predictable results. Second, even without an awareness of membranes as a substitute, it would have been obvious to a person of ordinary skill in the art to try reflective membranes as solutions for beam-deflecting. There were a relatively small number of alternative deflecting element solutions (such as MEMS micromirrors and comb-drive-actuated devices), and one of skill would have had a reasonable expectation for success in using reflective membranes.

The Patents-in-Suit themselves allege that (1) membranes were known in the prior art; and (2) that that one of skill in the art would have considered membranes as an option to implement beam deflecting mirrors, and (3) would have had a reasonable expectation of success doing so. This is because the Patents-in-Suit explicitly suggest the use of membranes in the alleged invention. "The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam — deflecting means known in the art." ('368 patent, 4:22-25.)

Using reflective membranes as beam-deflecting elements was not only known, their use was known within the same types of devices claimed in the Patents-in-Suit. As discussed below, membranes were known for use in optical switching applications within wavelength division multiplexing ("WDM") devices. For this reason, one of skill in the art would have a reasonable expectation of success using such membranes to implement the ROADM devices in the Patents-in-Suit. Membrane switches were so well known in 1996 there was an established acronym for them: "MARS" (mechanical antireflection switches). (Walker at 46.)

For example, the Bouevitch patent (that Capella admitted invalidated the pre-reissue claims of the Patents-in-Suit) disclosed the use of micromechanical membranes to act as modulators (beam deflecting elements) in WDM applications. Bouevitch explained that these modulators "include a movable membrane suspended above a substrate, defining a gap there between." (U.S. Patent No. 5,936,752 (Bishop '752") at 3:29-34 (incorporated in Bouevitch at 1:49-50.))

As another example, Joseph E. Ford and James A. Walker, Dynamic Spectral Power Equalization Using Micro-Opto-Mechanics, 10 IEEE Photonics Tech. Letters 1440, 1441 (1998), describes the use of MARS membrane switches to control power in WDM systems. This is the same application that Capella contended was a point of novelty in the Patents-in-Suit.

Id. at 47–49.

l. Dynamic and Continuous 2-Axis Control

A person of ordinary skill in the art would have been motivated to combine or modify the prior art to include dynamic and continuous 2-axis control for at least the following reasons stated in previously served invalidity contentions:

> Dynamically and continuously controlling 2-axis MEMS mirrors in fiber-optic systems was well known by 1999. For example, an application to Smith discloses "the optical throughput of each wavelength channel may be controlled by using a mirror array with elements that can be rotated in an analog fashion about two orthogonal axes" (U.S. Patent App. 60/234,683, p. 6); an application to Heanue described "...aoptical switching module 100 that were first made in March 1999, using 2D mirror surfaces 116 whose orientations were controlled by analog dual axis servo controllers" (U.S. Patent App. 2003/0223726, ¶ 48); a patent to Bishop disclosed "[a] typical requirement of optical crossconnects is that any input be capable of being connected to any output.... Each mirror ...is capable of operatively rotating or tilting about orthogonal X-Y axes, with the tilt angle being selectively determined by the amount of voltage applied to the control electrodes" (U.S. Patent No. 6,798,992, col. 2, ll. 55-65); a patent to Riza disclosed that "attenuation control in these modules is implemented in an analog fashion by carefully moving a micromirror per beam (or wavelength) through a continuous range of positions" (U.S. Patent No.6,222,954, col. 2, ll. 23-26). Dynamic control can be performed by a servo-control assembly (see '368 patent, col. 5, ll. 63-64; '678 patent, col. 5, ll. 63-64). Servos are well known in the art for dynamically controlling systems based on internal feedback, including for controlling mirrors in optical switching systems. (See, e.g., U.S. Patent App. 2003/0223726, ¶ 48).
>
> It would have been obvious to one of ordinary skill in the art to incorporate dynamic and continuous 2-axis mirror control features of the prior art with other optical switching devices as a matter of common sense and routine innovation. Also, such a combination would be merely the application of known elements to achieve predictable results, with a reasonable expectation of success.
>
> Analog control allows for more flexibility in the rotation of a MEMS mirror, along with greater precision, providing improved power/attenuation control and switching capability. (See, e.g., U.S. Patent No. 6,798,992, col. 2, ll. 55-65; U.S. Patent No. 6,222,954,

> col. 2, ll. 23-26). Additionally, dynamic control allows a MEMS mirror to be automatically adjusted based on system feedback to maintain desired power, coupling, and gain levels. A person skilled in the art would be motivated to incorporate the dynamic and continuous 2-axis mirror control features of the prior art with other optical switching devices in order to automatically maintain desired power, coupling and gain levels, and to have greater precision and rotation flexibility in a MEMS mirror (for example, to direct a wavelength channel to any output port as suggested by, e.g,, U.S. Patent No. 6,798,992, col, 2, ll. 55-56). Additionally, a person skilled in the art would be motivated to use the known dynamic and continuous 2-axis mirror control features of the prior art to improve similar devices, such as the devices disclosed in U.S. Patent No. 6,507,421, col. 3, l. 10-11,and U.S. Patent No. 6,253,001, col. 1, l. 65 to col. 2, 1. 13.
>
> Moreover, as there are only limited available options to try the substitution of discretely and manually controlled mirrors with dynamically and continuously controlled mirrors would have been obvious to try. (See, e.g., U.S. Patent No. 5,661,591,col. 2, ll. 7-9, col. 3, ll. 41-57).
>
> The prior art also expressly contemplates such a combination. For example, "it is well known that WDM systems must maintain a significant degree of uniformity of power levels across the WDM spectrum, so that dynamic range considerations at. receivers and amplifier, nonlinear effects, and cross talk impairments can be minimized, ...This equalization should be dynamic and under feedback control...." (U.S. Patent No. 6,798,941, col. 6, ll. 37-50; see also, id. at col. 2, ll. 23-31, col. 7, ll. 24-31; U.S. Patent App. 60/234,683, p. 6, Fig. 11; U.S. Patent No. 5,661,591,col. 2, ll. 7-9, col. 3, ll. 41-57). Thus, teachings of the prior art provide reasons to use dynamic and continuous 2-axis control.

Id. at 49–51.

m. Additional Motivations to Combine Presented during IPR Proceedings

FNC identifies and incorporates into these Contentions the following additional motivations to combine that were presented during IPR proceedings involving the ’368 and ’678 Patents.

> . . . To the PHOSITA, Bouevitch and Smith were combinable for purposes of establishing obviousness under 35 U.S.C. § 103(a). (Id.,

¶ 28-47.) Most of the *KSR* obviousness rationales support combining these two references. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 415-421 (2007); MPEP § 2141.

First, the use of Smith's 2-axis mirrors in Bouevitch's system is a simple substitution of one known, closely-related element for another that obtains predictable results. The 1-axis mirrors of Bouevitch and the 2-axis mirrors of Smith were known to be interchangeable. (Ex. 1028 at ¶¶ 39-41.) Smith expressly acknowledges this interchangeability: "in comparison to the two-axis embodiment, single axis systems may be realized using simpler, single axis MEMS arrays but suffer from increased potential for crosstalk between channels." (Ex. 1005 at 11; Ex. 1004 at 18:17-18.) Smith also states that "both single and dual axis mirror arrays may be used in a variety of switching configurations, although the two-axis components are preferred." (Ex. 1005 at 11; Ex. 1004 at 16:55-58; Ex. 1007 at 4:17-19 (claiming a crossconnect with "an array of tiltable mirrors comprising a plurality of mirrors, each mirror being tiltable ***about at least one*** tilting axis") (emphasis added).)

Second, combining Bouevitch with Smith is nothing more than the use of known techniques to improve similar devices. PHOSITA could use the 2-axis mirrors of the Smith ROADM as a replacement for the 1-axis mirrors in the similar Bouevitch ROADM. (Ex. 1028 at ¶¶ 42-44.) Each reference discusses devices in the same field of fiber optic communications (Ex. 1003 at 1:18; Ex. 1004 at 1:10-15; Ex. 1005 at 1). Each reference is directed at the same application in that field—optical switching for multi-wavelength WDM communications. (Ex. 1003 at Abstract; Ex. 1004 at Title.) Each reference discloses the same type of optical switch—a COADM. And each COADM uses the same type of WSS for switching—a MEMS-based optical add/drop multiplexer. As a result, using the known 2-axis mirrors in the Bouevitch ROADM is nothing more than the use of known techniques to improve similar devices. (Ex. 1028 at ¶¶ 42-44.) And using 2-axis mirrors for power control instead of 1-axis mirrors would yield the same predictable result for power control if used in the MEMS-based switch of Bouevitch. (Ex. 1028 at ¶¶ 43-45.) Rotation about either 1 or 2 axes would result in controllable misalignment to alter power. (Ex. 1028 at ¶¶ 43-45.)

Third, it would be obvious to try Smith's 2-axis mirrors in Bouevitch because 2-axis mirrors were among a small number of identified, predictable solutions, and PHOSITA had a high expectation of success with either. (Ex. 1028 at ¶ 45.) There are only two options for tilting MEMS mirrors: 1-axis and 2-axis mirrors. (Ex. 1028 at ¶ 45) Because Smith already disclosed the use of 2-axis mirrors

> (which were available by the '368 patent's priority date), PHOSITA would have a high expectation of success to try 2-axis mirror control in Bouevitch, both for switching and power control. (Ex. 1028 at ¶ 45.) And the impact of tilting in 1 or 2 axes for the steering of a light beam is entirely predictable. (See id., '368 patent, 4:25-29 (2-axes allows 2-D steering); Ex. 1028 at ¶ 45.)
>
> Fourth, Smith and Bouevitch, as well as other contemporaneous prior art, provide explicit motivations to combine the references. For example, PHOSITA would be motivated to use the 2-axis mirrors of Smith with the system of Bouevitch to reduce crosstalk in attenuation. (Ex. 1004 at 18:17-18; Ex. 1028 at ¶¶ 46-47.) Crosstalk is reduced by performing beam misalignment in a different axis than the axis used for switching. (Id.; Ex. 1004 at 16:55-59, 18:18-25.) The PHOSITA would also be motivated to use the 2-axis mirrors of Smith with the Bouevitch COADM to increase port density. (Ex. 1028 at ¶¶ 47, 69.) Compact, two-dimensional arrays of fiber ports can be utilized when two-axis mirrors allow beams to be steered in two dimensions to those ports. (Ex. 1028 at ¶ 47; Ex. 1003 at 2:9-21; Ex. 1007 at 3:10-11; Ex. 1009 at 2:1-16.)
>
> Finally, the Patentee's admission during prosecution that claim 1 was invalid over Bouevitch "further in view of one or more of" Ma, Jin, and Wagener also confirms that one of skill in the art would have been motivated to combine Bouevitch with Petitioner's other references which are similar to Ma, Jin, and Wagener. (See Ex. 1002 at 81-82.) By admitting that claim 1 was ***invalid*** over Bouevitch "further in view of one or more of" Ma, Jin, and Wagener, the Patentee also admitted the ***combinability*** of such references. This admission is important because Smith and other references that Petitioner combines with Bouevitch here are directed at the identical technology area as Ma Jin, & Wagener—MEMS-based optical switches for WDM. (See Ex. 1023 at 1:6-11, Ex. 1024 at 1:11-20, 2:27-39, Ex. 1025 at 3:20-34, 5:32-43.) Thus, the references Petitioner relies on here are also combinable.

Cisco Sys., Inc. v. Capella Photonics, Inc., Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2014-01166, at *19–23 (PTAB July 15, 2014); *see also, e.g.*, *id.* at 23–60 (discussing motivations to combine while discussing obviousness); *Cisco Sys., Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Patent No. RE42,678, IPR2014-01276 (PTAB Aug. 12, 2014) (applying a similar analysis to the '678 Patent).

> Petitioner submits that no showing of specific motivations to combine the respective references in Grounds 2-6 (set forth below) is required, as the respective combinations would have no unexpected results, and at most would simply represent known alternatives to one of skill in the art. *See KSR Int'l Co. v. Teleflex, Inc.*, 127 S.Ct. 1727, 1739-40 (2007). Indeed, the Supreme Court held that a person of ordinary skill in the art is "a person of ordinary creativity, not an automaton" and "in many cases a person of ordinary skill in the art will be able to fit the teachings of multiple patents together like pieces of a puzzle." *Id.* at 1742. Nevertheless, specific motivations and reasons to combine the references are identified below.

Fujitsu Network Comm'ns, Inc. v. Capella Photonics, Inc., Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,368, IPR2014-01166, at *15–16 (PTAB July 15, 2014); *see also Fujitsu Network Comm'ns, Inc. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Reissued Patent No. RE42,678, IPR2015-00727 (PTAB Feb. 12, 2015) (applying a similar analysis, including for the below-cited portions of the -01166 Petition for the '368 Patent).

> A PHOSITA would have been motivated to combine Bouevitch with Carr for a number of independent reasons. *See* Ex. 1016 ¶ 141. Fundamentally, the two references cover highly related subject matter. Each reference discusses devices in the same field of fiber optic communications. Ex. 1005 at 1:6–15; Ex. 1002 at 1:10–19. Each reference is directed at the same application in that field—optical switching for wavelength-division-multiplexed (WDM) communications. Each reference discloses an optical add/drop switch using a MEMS-based WSS for switching. As a result, using the known 2-axis mirrors from Carr in the Bouevitch COADM would have been nothing more than using known techniques to improve similar devices. Because of the similarity between the devices disclosed in each reference, a PHOSITA would expect that each of these well-known techniques could be applied to the devices of the other patent.
>
> A PHOSITA would find it natural and obvious to combine teachings of Carr with the disclosure of Bouevitch. Ex. 1016 ¶ 142, Drabik Decl. Namely, providing the MEMS mirrors of Bouevitch with two-axis tilt capability enables the spatial positioning of returning beams in both transverse directions at the face of microlens array 12. Thus, errors in system alignment arising, e.g., from imperfect assembly or temperature changes—well known problems in free space optical systems—could be better compensated. Likewise, a PHOSITA

would seize upon Carr's teachings of feedback control for improved stabilization of mirror position and out-coupled optical power.

For example, a PHOSITA would have been motivated to combine the two-axis movable MEMS mirrors of Carr in the COADM of Bouevitch based on the teachings of the references, common sense and knowledge generally available to a PHOSITA, as the proposed combination would merely be substituting known elements to yield predictable results. Bouevitch discloses a COADM where multiwavelength light is spatially dispersed into channels by a diffraction grating and each channel is reflected by a different mirror in an array of MEMS mirrors along a different path for adding and dropping optical signals. Ex. 1002 at 14:14–15:18, Fig. 11. Carr discloses a two-dimensional array of double-gimbaled (i.e., two axes) movable MEMS mirrors that can be tilted to "any desired orientation." Ex. 1005 at 3:44–48. As a result, using the known two-axis mirrors of Carr in the Bouevitch COADM is nothing more than substituting known elements to yield predictable results. Ex. 1016 ¶ 143, Drabik Decl.

Also, it would have been obvious to try Carr's two-axis mirrors in Bouevitch because two-axis mirrors were among a small number of identified, predictable solutions, and a PHOSITA had a high expectation of success with two-axis mirrors. Ex. 1016 ¶ 144. There are only two options for tilting MEMS mirrors: one-axis and two-axis mirrors. Because Carr already disclosed the use of two-axis mirrors (which were available by the '368 Patent's priority date), a PHOSITA would have a high expectation of success upon trying two-axis mirror control in Bouevitch. *Id.* The impact of tilting in one or two axes for the steering of a light beam was entirely predictable to a PHOSITA. *See* Exs. 1018, 1025.

Additionally, a PHOSITA would have been motivated to combine the continuously controllable mirrors of Carr with the COADM of Bouevitch. A PHOSITA would have been motivated to combine the teachings of these references at least for the following reasons: (1) continuously controlled mirrors were known to be an alternative to digital (discretely positioned) mirrors; (2) continuously controlled mirrors allow arbitrary positioning of mirrors and provide more precise control of reflected signals; and (3) Carr specifically teaches that its analog, continuous micromirrors would be useful for power control applications in WDM systems. Ex. 1005 at 11:20–23.

The prior art teaches that continuously controllable mirrors were an interchangeable alternative to digital (discrete-step) mirrors. *See, e.g.*, Ex. 1007 at [0030]; Ex. 1008 at 9:9–15; Ex. 1033 at 2:7–9, 3:41–57. A PHOSITA would have known that MEMS mirrors based

on analog voltage control can be tilted to any desired angle in their operation range. Ex. 1016 ¶¶ 145-147, Drabik Decl.

A PHOSITA would have known to use continuously controllable mirrors to equalize or otherwise attenuate an optical signal. Carr teaches that the mirrors "can be tilted to any desired orientation" and that "[f]ine control over the mirror orientation" provides "fine control of the degree of attenuation." Ex. 1005 at 1:49–50, 3:47–48, 11:20–23. In addition, other prior art references recognize that having individual control over each channel of an optical signal by continuously altering the position of each mirror provides control on a channel basis and allows for power balancing. See, e.g., Ex. 1007 at [0017], [0038]. Thus, a PHOSITA would have been motivated to use continuously controllable micromirrors of Carr in the device of Bouevitch to equalize or otherwise attenuate an optical signal.

As another example, a PHOSITA would have been motivated to combine the power control method and input/output ports of Carr in the COADM of Bouevitch. Ex. 1016 ¶ 148, Drabik Decl. Bouevitch discloses a COADM where multi-wavelength light is spatially dispersed into channels by a diffraction grating and each channel is reflected by a different mirror in a MEMS array along a different path for adding and dropping optical signals. Ex. 1002 at 14:14–15:18, FIG. 11. Carr discloses a power control method of orienting each of the double-gimbaled, two axis movable MEMS mirrors so that only a portion of a signal reflected off each MEMS mirror enters an optical fiber. Ex. 1005 at 11:11–20. A PHOSITA would have known that power control of each channel may be achieved by intentional misalignment of the reflected beam so that only a portion of the signal enters the output port. *Id.*; see also Ex. 1006 at 4:48–58; Ex. 1007 at [0030], [0038]; Ex. 1008 at 9:9–15.

Bouevitch recognizes that the degree of attenuation may be based on the angle of deflection off each MEMS mirror. Ex. 1002 at 7:31–37. Although Bouevitch does not expressly disclose intentional misalignment into an output port as a method to achieve attenuation, Bouevitch recognizes the principle that angular displacement may be used as the root mechanism to attenuate to signal. *See id.* Bouevitch does not teach away from angular displacement as an attenuation mechanism, rather it only recognizes that there is no need to intentionally misalign a signal into an output port for purposes of attenuation where the signal has already been attenuated elsewhere in the optical system. See id. at 7:41–43 ("As a result the attenuated sub-beam is refracted in the birefringent element 156 and is directed out of the device to port 102 b."). Carr teaches that MEMS mirrors may be oriented to intentionally misalign signals into output ports for purposes of power control of each channel. Ex.

> 1005 at 11:13–25. Additionally, Carr discloses an array of input/output ports through which only a portion of the optical signals may enter for power control. *Id.* at 11:13–33, FIG. 1b. A PHOSITA would have recognized that Carr provides an alternative attenuation technique that does not require the use of birefringent elements as disclosed in Bouevitch. Ex. 1016 ¶ 149, Drabik Decl. Other references expressly state that attenuation by intentional misalignment obviates the need for separate attenuation devices. Ex. 1006 at 4:48–58 (stating that by deliberately misaligning the optical beam path "attenuation is achieved without incorporating separate attenuator(s) within the system"). Thus, a PHOSITA would have been motivated to use the power control method and input/output ports of Carr in the COADM disclosed in Bouevitch, in order to attenuate optical signals. Ex. 1016 ¶ 149, Drabik Decl.
>
> Additionally, the references are in a common field of endeavor (routing optical signals using MEMS-based WSSs), with a finite number of conventional and predictable solutions to the routing issues addressed by the references, such that it would have been obvious to try one of the solutions described in Carr (*e.g.*, two-axis mirrors and misalignment for power control) with the COADM device disclosed in Bouevitch, with a reasonable expectation of success.

Id. at 26–31.

> A PHOSITA would have been motivated to combine Bouevitch with Sparks for a number of independent reasons. A PHOSITA would have been motivated to combine Bouevitch with Sparks for many of the same reasons as discussed above with respect to the combination of Bouevitch and Carr. Thus, the motivations to combine of Ground 1 are incorporated herein by reference.
>
> For example, a PHOSITA would have been motivated to combine the twoaxis movable MEMS mirrors of Sparks in the COADM of Bouevitch based on the teachings of the references, common sense and knowledge generally available to a PHOSITA, as the proposed combination would merely be substituting known elements to yield predictable results. Bouevitch discloses a COADM where multi-wavelength light is spatially dispersed into channels by a diffraction grating and each channel is reflected by a different mirror in an array of MEMS mirrors along a different path for adding and dropping optical signals. Ex. 1002 at 14:14-15:18, Fig. 11. Sparks discloses using movable micromirrors capable of two axes movement so that "each of the channels passing through the switch may be attenuated to whatever degree necessary to achieve the desired effect." Ex. 1006 at 2:30-35; 4:39-47. As a result, using the known two-axis

mirrors of Sparks in the Bouevitch COADM entails nothing more than the use of known techniques to improve similar devices. Ex. 1016 ¶¶ 152-159, Drabik Decl.

A PHOSITA also would have been motivated to combine the power control method and input/output ports of Sparks within the COADM of Bouevitch. Ex. 1016 ¶ 160. Bouevitch discloses a COADM where multi-wavelength light is spatially dispersed into channels by a diffraction grating and each channel is reflected by a different mirror in a MEMS array along a different path for adding and dropping optical signals. Ex. 1002 at 14:14–15:18, FIG. 11. Sparks discloses deliberately misdirecting an optical beam path reflected from a moveable MEMS mirror so that only a portion of the beam power couples into an optical fiber, in order to achieve a desired output power. Ex. 1006 at 4:48–58; 5:1–11.

Bouevitch recognizes that the degree of attenuation may be based on the beam deflection angle imposed by each MEMS mirror. Ex. 1002 at 7:31–37. Although Bouevitch does not expressly disclose intentional misalignment into an output port as a method to achieve attenuation, Bouevitch recognizes the principle that angular displacement may be used as the root mechanism to attenuate a signal. *See id.* Bouevitch does not teach away from angular displacement as an attenuation mechanism, rather it only recognizes that there is no need to deliberately misalign a signal into an output port for purposes of attenuation where the signal has already been attenuated elsewhere in the optical system. *See id.* at 7:41–43 (“As a result the attenuated sub-beam is refracted in the birefringent element 156 and is directed out of the device to port 102 b.”). Sparks teaches that MEMS mirrors may be oriented intentionally to misalign signals into output ports for purposes of power control of each channel. Ex. 1006 at 2:26–39; 4:48–58. Additionally, Sparks discloses two input ports and two output ports through which only a portion of the optical signals may enter for power control. *Id.* at 2:66–3:9, FIG. 2b. A PHOSITA would have recognized that Sparks provides an alternative attenuation technique that does not require the use of the additional birefringent elements disclosed in Bouevitch. Ex. 1006 at 4:48–58. Thus, a PHOSITA would have been motivated to use the power control method and input/output ports of Sparks in the COADM disclosed in Bouevitch to attenuate optical signals. *Id.*; Ex. 1016 ¶ 161, Drabik Decl.

As a further example, a PHOSITA would have been motivated to combine the servo control system of Sparks in the COADM of Bouevitch. Ex. 1016 ¶¶ 162-163, Drabik Decl. It would be obvious to a PHOSITA to combine the internal closed-loop servo control system of Sparks in Bouevitch as an alternative to the detector array

> used for purposes of gain equalization. Capella admitted that Figure 6b of Bouevitch illustrates a dynamic gain equalizer where detector array 657 is located inside the ROADM next to reflecting mirrors and that Bouevitch uses this approach to "'eliminat[e] the need for external feedback.'" IPR2014-01276, Paper No. 7 at 38–39 (quoting Ex. 1003 at 10:20–22). Sparks discloses a servo-control system within an optical switch that similarly eliminates the need for external feedback. Ex. 1006 at 4:39–67, Fig. 4; A PHOSITA would have been motivated to use the internal feedback system of Sparks in the COADM of Bouevitch "to ensure that the desired degree of attenuation of achieved for each optical signal (or channel)." Ex. 1006 at 2:62–65; *see also* Ex. 1001 at 12:9–15.

Id. at 48–51.

> To the extent Smith does not fully disclose continuous mirror control, Tew discloses this requirement and it would have been obvious to substitute Tew's analog control into the two-axis mirrors of Smith. Ex. 1016 at ¶¶ 168-170, Drabik Decl. A PHOSITA would have been motivated to combine the teachings of these references at least for the following reasons: (1) continuously controlled mirrors were known to be an alternative to digital mirrors; (2) continuously controlled mirrors allow arbitrary positioning of mirrors and provide more precise control of reflected signals; and (3) Tew specifically teaches that its analog, continuous micromirrors would be useful for power control applications in WDM systems. Ex. 1007 at [0017] & [0030]; Ex. 1008 at 5:1-5, 9:11-15.
>
> In addition, analog (continuous) control of the mirrors would be obvious to try because there are only two general options for such control—either analog (continuous) or digital control. Ex. 1007 at [0030] & [0031]; Ex. 1008 at 9:10-10:3. For example, Tew discusses analog control as the alternative to digital control of mirrors to increase the precision of the rotation of the micromirrors. Ex. 1007 at [0059] & [0078]; Ex. 1008 at 18:8-16, 24:1-10. With only two options, both of which were known in the prior art, and both of which were suggested as working solutions for control, a PHOSITA would have expected that analog control would work well with the two axis mirrors of Smith. Ex. 1016 at ¶ 171.

Id. at 58–59.

> . . . To the PHOSITA, Bouevitch and Sparks were combinable for purposes of establishing obviousness under 35 U.S.C. § 103(a). (*Id.*, ¶ 29-37.) Most of the KSR obviousness rationales support combining these two references. (*KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 415-421 (2007); MPEP § 2141.)

First, Bouevitch and Sparks represent analogous art. Both Bouevitch and Sparks are directed to the same field: communication using optical switch multiplexors (Ex. 1003 at 1:10-15 and 31-34; Ex. 1004 at 4:3-14, 33-38, and 59-60). It is noted that Lin and Dueck are similarly directed to optical switch multiplexors (Lin, Ex. 1010 at Title; Dueck, Ex. 1021 at 3:3-5). This is the same field of endeavor as the '368 Patent (Bouevitch, Ex. 1003 Abstract.) Bouevitch and Sparks are both directed to the same application in that field: optical switching for multi-wavelength WDM communications. (Ex. 1003 at Abstract; Ex. 1004 at 2:30-36.) Furthermore, the actuating mirrors of Sparks and Bouevitch are both MEMS-based. (Ex. 1003 at 14:5-10 and 52-65; Ex. 1004 at 4:42-47). As such, Bouevitch and Sparks (and further Lin and Dueck) are analogous art and the PHOSITA would have understood that the teachings of any one reference would be readily applicable to the others. (McLaughlin Decl., Ex. 1028 at ¶ 30.)

Second, the use of Sparks' 2-axis mirrors in Bouevitch's system is a simple substitution of one known, closely-related element for another that obtains predictable results. The 2-axis actuating mirrors are described by Sparks to "precisely direct[] the beam" (Ex. 1004 at 4:21) and to "carefully align the beams so as to ensure that the maximum possible input optical signal is received at the output of the switch" (*Id.* at 4:45-47.) The PHOSITA would expect that using the 2-axis MEMS-based mirrors of Sparks for directing a beam of light in place of the 1-axis MEMS-based mirrors of Bouevitch would yield a predictable result of the same functionality (e.g., movement of a reflective service in a first axis) yet with more control (e.g., the reflective surface moving in a second axis in similar manner as the movement in the first axis). (McLaughlin Decl., Ex. 1028 at ¶ 31.) Likewise, the power control teachings of Sparks "may equally be applied to any optical switch utilising any one or more of reflection, refraction and/or diffraction, in which the optical beam path through the switch can be misaligned so as to attenuate the resultant output signal." (Ex. 1004 at 5:58-62; McLaughlin Decl., Ex. 1028 at ¶ 36.) As a result, using the known 2-axis mirrors for power control in the Bouevitch switch is nothing more than the use of known techniques to improve similar devices with predictable results. (McLaughlin Decl., Ex. 1028 at ¶¶ 30-32, 35-36.)

Third, it would be obvious to try Sparks' 2-axis actuating mirrors in Bouevitch because 2-axis actuating mirrors were among a small number of identified, predictable solutions for mirror actuation and the PHOSITA had a high expectation of success if Bouevitch's 1-axis actuating mirror were to be replaced with Sparks' 2-axis actuating mirror. (McLaughlin Decl., Ex. 1028 at ¶ 32.) Because

> Sparks already disclosed the use of 2-axis actuating mirrors by the '368 Patent's priority date, the PHOSITA would have a high expectation of success to try 2-axis mirror control in place of Bouevitch's 1-axis actuating mirror, both for switching and power control. (McLaughlin Decl., Ex. 1028 at ¶¶ 31-32, 36.)
>
> Fourth, Sparks and Bouevitch provide explicit motivations to combine the references. Sparks addresses a problem, and is directed to a goal, identified in Bouevitch. Specifically, Bouevitch states that "[i]n WDM systems it is desirable to ensure that all channels have nearly equivalent power." (Ex. [1003] 1:20-22.) Directly on point, Sparks states that "[i]n wavelength division multiplexed (WDM) transmission, it is desirable to control the power of the individual optical channels or wavelengths . . .[o]ne of the simplest methods of control is to maintain each of the power levels of the individual wavelength components (channels) at substantially the same level." (Ex. 1004 at 1:19-25). To maintain the desired equal channel power levels, Sparks teaches "controlled misalignment of the optical beam path so as to achieve a predetermined optical output power . . . If the optical system is being used as part of a WDM system, it is typical for the signal to be demultiplexed into the separate optical channels prior to input to the switch. If desired, each of the channels passing through the switch may be attenuated to whatever degree necessary to achieve the desired effect, e.g. equalisation of optical power across all channels." (Ex. 1004 at 2:24-36.) As such, the PHOSITA would have been motivated to utilize the 2-axis actuating mirror power control feature of Sparks for addressing the need, identified by Bouevitch, to help ensure that all channels have nearly equivalent power. (McLaughlin Decl., Ex. 1028 at ¶¶ 35-37.)
>
> Finally, 2-axis mirrors, as in Sparks, were known to overcome manufacturing deviations by being actuatable to adjust for any unintentional misalignment in 2-axes. (McLaughlin Decl., Ex. 1028 at ¶¶ 34.) In conclusion, the teachings of Bouevitch are combinable with those of Sparks under §103(a).

JDS Uniphase Corp. v. Capella Photonics, Inc., Patent No. RE 42,368, IPR2015-00731, at *21–24 (PTAB Feb. 13, 2015); *see also id.* at 24–60 (discussing motivations to combine while discussing obviousness); *JDS Uniphase Corp. v. Capella Photonics, Inc.*, Petition for *Inter Partes* Review of U.S. Patent No. RE42,678, IPR2015-00739 (PTAB Feb. 14, 2015) (applying a similar analysis to the '678 Patent).

IV. P.R. 3-3(c): CLAIM CHARTS

Pursuant to Local P.R. 3-3(c), and subject to FNC's reservation of rights contained herein, the invalidity claim charts, attached hereto as Appendices A-1 through A-21 and B-1 through B-21, identify where in each item of prior art each element of each asserted claim is found for the Asserted Claims, including for any element that is governed by pre-AIA 35 U.S.C. § 112, ¶ 6 and/or post-AIA 35 U.S.C. § 112(f), the identity of the structure(s), act(s), or material(s) in each item of prior art that performs the claimed function. The structure(s), act(s), or material(s) identified by FNC, and the associated structure(s), act(s), or material(s) recited in each item of prior art, perform(s) each element's claimed function. Any elements of the Asserted Claims that are governed by 35 U.S.C. § 112, ¶ 6 and/or post-AIA 35 U.S.C. § 112(f) are identified below in section VI.A.

The cited portions of the prior art references are examples and representative of the content of the prior art references, and should be understood in the context of the reference as a whole, as understood by one of ordinary skill in the art. To the extent any cited prior art reference fails to explicitly teach or suggest one or more limitations of that claim, the limitation would nonetheless have been inherent in and/or implied by the reference and/or obvious to one of ordinary skill in the art at the time of the alleged invention(s), either alone or by the combination of the cited prior art references with any of the other listed references and/or common knowledge disclosing the missing claim limitations. Non-limiting examples of certain combinations are outlined above. It should be understood that citations within each exhibit are exemplary, not exhaustive, and should not be construed as the sole evidentiary support in the reference.

V. P.R. 3-3(d): INVALIDITY BASED ON INDEFINITENESS, LACK OF ENABLEMENT, AND LACK OF WRITTEN DESCRIPTION

Pursuant to Local P.R. 3-3(d), and subject to FNC's reservation of rights, FNC includes below the grounds on which FNC contends the Asserted Claims are invalid based on indefiniteness, lack of written description, and/or lack of enablement under pre-AIA 35 U.S.C. § 112.

As noted above, Capella has not yet provided a claim construction for any of the terms and phrases that FNC anticipates will be in dispute. FNC, therefore, cannot provide a complete list of its indefiniteness, lack of written description, and lack of enablement defenses because FNC does not know whether Capella will proffer a construction for certain terms and phrases that would be broader than, or inconsistent with, a construction supportable by the disclosure set forth in the specification. Accordingly, FNC reserves the right, to the extent permitted by the Court and the applicable statutes and rules, to supplement, amend, and/or modify these indefiniteness, lack of written description, and lack of enablement defenses as discovery progresses and in accordance with Capella's claim construction, infringement and validity disclosures.

A. Indefiniteness

Pre-AIA 35 U.S.C. § 112, ¶ 2 contains two requirements: "first, [the claim] must set forth what the applicant regards as his invention and second, it must do so with sufficient particularity and distinctness, i.e., the claim must be sufficiently definite." *Allen Eng'g Corp. v. Bartell Indus., Inc.*, 299 F.3d 1336, 1348 (Fed. Cir. 2002) (internal quotes removed) (quoting *Solomon v. Kimberly-Clark Corp.*, 216 F.3d 1372, 1377 (Fed. Cir. 2000)); *see also Justacomm-Texas Software, LLC, v. Axway, Inc.*, Case No. 6:10-cv-00011-LED, Dkt. No. 1079 at 6 (E.D. Tex. July 5, 2012). "A determination of whether a claim recites the subject matter which the applicant regards as his invention and is sufficiently definite, so as to satisfy the requirements of 35 U.S.C.

§ 112, ¶ 2, is a legal conclusion . . . ." *Allen Eng'g*, 299 F.3d at 1343. Under the first requirement of pre-AIA § 112, ¶ 2, a court must hold a claim invalid "[w]here it would be apparent to one of skill in the art, based on the specification, that the invention set forth in [the] claim is not what the patentee regarded as his invention." *Id.* at 1349.

Under the second requirement of pre-AIA § 112, ¶ 2, a claim is sufficiently definite only if, viewed in light of the specification and prosecution history, it informs those skilled in the art about the scope of the invention with reasonable certainty. *Nautilus, Inc. v. Biosig Instruments, Inc.*, 572 U.S. 898 (2014). Various Asserted Claims identified below do not comply with the requirements of pre-AIA 35 U.S.C. § 112, ¶ 2, for failing to particularly point out and distinctly claim "the subject matter which the applicant regards as his invention" for the following reasons. For example, as demonstrated either individually or collectively by the claim elements addressed below, various Asserted Claims fail to inform those skilled in the art about the scope of the invention with reasonable certainty, rendering those claims (and any claims depending therefrom) invalid as indefinite.[23] The following chart identifies the claims in which the identified terms and phrases explicitly appear, although those identified terms and phrases are also incorporated into additional dependent Asserted Claims. FNC's contentions as to indefiniteness also include those dependent claims. Additionally, to the extent any Asserted Claim containing the identified limitations or phrases or substantially identical limitations or phrases is not specifically identified in the table below, FNC still identifies such a claim based on its inclusion of such term or phrase.

[23] FNC's analysis is preliminary, and FNC reserves the right to assert claim constructions other than "indefinite" for each of the terms identified below.

Claim Terms / Phrases	**Asserted Claims**	**Category**
"fiber collimators serving as an input port and one or more other ports" / "fiber collimator input port" / "a fiber collimator seving as an input port" / "one or more fiber collimators serving as one or more drop ports" / "fiber collimator add port" / "fiber collimator drop port" / "said fiber collimator serving as said drop ports" / "a fiber collimator serving as an input port" / "one or more fiber collimators serving as one or more add ports" / "one or more fiber collimator serving as drop ports" / "multiple fiber collimators, providing and serving as an input port for a multi-wavelength optical signal and a plurality of output ports" / "multiple fiber collimators, providing an input port for a multi-wavelength optical signal and a plurality of output ports" / "fiber collimators providing and serving as an input port for a multi-wavelength optical signal" / "fiber collimators, providing and serving as an input port for a multi-wavelength optical signal" / "multiple auxiliary fiber collimators, providing and serving as a plurality of auxiliary input ports" / "a fiber collimator input port"	'905 Patent, Claims 23, 32, 47, 49, 51 '906 Patent, Claims 68, 89, 100, 115, 126, 133	1

"a spatial array of beam deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port" / "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports and to control the power of the spectral channel reflected to said output port of the fiber collimator serving as said selected port" / "a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports and to control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port, whereby said spectral channels from said fiber collimators serving as said add ports are selectively provided to said output port" / "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports" / "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said fiber collimator output ports" / a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually and	'905 Patent, Claims 23, 47, 49 '906 Patent, Claims 68, 89, 100, 115, 126	1, 2

Claim Terms / Phrases	Asserted Claims	Category
continuously controllable to reflect said spectral channels into selected ones of said output ports" / "a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels" / "a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors"		
"beam-deflecting elements"	'905 Patent, Claims 23, 47, 49, 51, 52; '906 Patent, Claim 133	1, 2
"each of said elements being individually and continuously controllable in two dimensions" / "controlling dynamically and continuously said beam-deflecting elements in two dimensions" / "controlling dynamically and continuously other beam deflecting elements" / "said channel micromirrors being pivotal about two axes and being individually and continuously controllable" / "said channel micromirrors being individually controllable" / said channel micromirrors being pivotal about two axes and being individually and continuously controllable" / "dynamically and continuously controlling said beam-deflecting elements in two dimensions"	'905 Patent, Claims 23, 47, 49, 52 '906 Patent, Claims 68, 89, 115, 133	1

Claim Terms / Phrases	**Asserted Claims**	**Category**
"reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports" / "reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports" / "reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports" / "reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports" / "reflect said spectral channels into selected ones of said fiber collimator output ports" / "reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports" / "direct said spectral channels into any selected ones of output ports and to control the power of the spectral channels coupled into said selected output ports"	'905 Patent, Claims 23, 47, 49 '906 Patent, Claims 68, 89, 115, 133	1
"control the power of the spectral channel reflected to said output port or the fiber collimator selected port" / "control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port" / "control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port" / "control the power of the spectral channels combined into said output multi-wavelength optical signal" / "control the power of said received spectral channels coupled into said fiber collimator output ports" / "control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels" / "control the power of the spectral channels coupled into said selected output ports"	'905 Patent, Claims 23, 47, 49, 51 '906 Patent, Claims 68, 115, 133	1
"a control unit for controlling each of said beam-deflecting elements"	'905 Patent, Claim 24	1, 2
"a servo-control assembly"	'905 Patent, Claim 25 '906 Patent, Claims 69, 89, 116	1, 2

Claim Terms / Phrases	**Asserted Claims**	**Category**
"a spectral monitor for monitoring power levels of selected ones of said spectral channels" / "a spectral monitor for monitoring power levels of said spectral channels coupled into said fiber collimator output ports" / a spectral monitor for monitoring power levels of said spectral channels coupled into said output ports"	'905 Patent, Claim 25 '906 Patent, Claims 70, 90, 117	1, 2
"a processing unit responsive to said power levels for controlling said beam-deflecting elements" / "a processing unit responsive to said power levels for providing control of said channel micromirrors" "a processing unit responsive to said power levels for providing control of said channel micromirrors" / "a processing unit responsive to said power levels for providing control of said channel micromirrors"	'905 Patent, Claim 25 '906 Patent, Claims 70, 90, 117	1, 2
"said servo-control assembly maintains said power levels at predetermined values" / "said servo-control assembly maintains said power levels at a predetermined value" / "maintaining power levels of said spectral channels directed into said output ports at a predetermining value"	'905 Patent, Claim 26 '906 Patent, Claims 71, 91, 135	1
"second spectral channels"	'905 Patent, Claim 27	1

Claim Terms / Phrases	Asserted Claims	Category
"alignment mirrors for adjusting alignment of said input and output multi-wavelength optical signals and said second spectral channels with said wavelength-selective device" / collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports" / "collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimator input and output ports, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said fiber collimator output ports" / "collimator-alignment mirrors, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports" / "collimator-alignment mirrors, in optical communication with said wavelength-separator and said fiber collimators, for adjusting an alignment of said multi-wavelength optical signal from said fiber collimator input port and directing said reflected spectral channels into said output ports"	'905 Patent, Claim 29 '906 Patent, Claims 72, 92, 100, 118	1, 2
"none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator" / "none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator" / "neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator" / "neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator" / "neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator" / "neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"	'905 Patent, Claims 37, 48, 50 '906 Patent, Claims 88, 99, 106, 132	1
"a power-management system configured to manage power levels of at least one of the first spectral channels and the second spectral channels"	'905 Patent, Claim 44	1, 2

Claim Terms / Phrases	**Asserted Claims**	**Category**
"the power-management system is further configured to control coupling efficiency of one of the first and second spectral channel to at least one port"	'905 Patent, Claim 45	1, 2
"imaging each of said spectral channels onto a corresponding beam-deflecting element" / "imaging other spectral channels onto other corresponding beam-deflecting elements"	'905 Patent, Claims 51, 52	1
"an output port that transmits the output multi-wavelength optical signal to an optical fiber"	'905 Patent, Claim 51	1
"maintaining a predetermined coupling"	'906 Patent, Claims 69, 89, 116, 134	1
"any selected ones of output ports"	'906 Patent, Claim 133	1
"predetermining value"	'906 Patent, Claim 135	1
"said fiber collimator input and output ports are arranged in a one-dimensional array"	'906 Patent, Claim 80	1

The above limitations of the Asserted Claims, even when read in light of the specification and prosecution history, fail to inform with reasonable certainty one of ordinary skill in the art about the scope of the invention. For example, to one skilled in the art, at least the terms identified as part of Category 1 are not adequately defined in the common specification for the Asserted Patents. Their lack of reasonably ascertainable scope is compounded by Capella's overbroad and vague infringement contentions. Thus, the Asserted Claims fail to distinctly claim the subject matter that the applicant regards as the invention and are invalid under the second paragraph of pre-AIA 35 U.S.C. § 112. *See Nautilus*, 572 U.S. at 907–911.

In addition, numerous of the claim terms and limitations in the Asserted Claims are indefinite under 35 U.S.C. § 112 because they should be subject to means-plus-function interpretation, and the patent specification fails to disclose adequate structure to perform the claimed function(s). *See Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1348, 1350 (Fed. Cir. 2015). For example, at least the terms identified as part of Category 2 are claimed in purely

functional language and "do[] not provide any indication of structure because [they] set[] forth the same black box recitation of structure for providing the same specified function as if the term 'means' had been used." *Id.* at 1348. Nor would these terms be understood by one of ordinary skill in the art to have a sufficiently definite structure. These terms should therefore be treated as means-plus-function limitations. The common specification of the Asserted Patents fails to provide an adequate disclosure of structure for performing the recited functions claimed for these "nonce"/"means" terms, which are therefore indefinite under 35 U.S.C. § 112, ¶ 2.

B. Lack of Written Description

Various Asserted Claims are invalid for failure to comply with the written description requirement under pre-AIA 35 U.S.C. § 112, ¶ 1. To satisfy the written description requirement, the description must "clearly allow persons of ordinary skill in the art to recognize that [the inventor] invented what is claimed." *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010). In other words, the test for sufficiency is whether the disclosure of the application relied upon reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date. *Id.*

The test requires an objective inquiry into the four corners of the specification from the perspective of a person of ordinary skill in the art. Based on that inquiry, the specification must describe an invention understandable to that skilled artisan and show that the inventor actually invented the invention claimed. "Whether the written description requirement is satisfied is a fact-based inquiry that will depend on the nature of the claimed invention and the knowledge of one skilled in the art at the time an invention is made and a patent application is filed." *Carnegie Mellon Univ. v. Hoffmann La Roche Inc.*, 541 F.3d 1115, 1122 (Fed. Cir. 2008).

Actual "possession" or reduction to practice outside of the specification is not enough. Rather, as stated above, it is the specification itself that must demonstrate possession. Moreover,

while the description requirement does not demand any particular form of disclosure, *id.*, or that the specification recite the claimed invention *in haec verba*, a description that merely renders the invention obvious does not satisfy the requirement. *Lockwood v. Am. Airlines*, 107 F.3d 1565, 1571–72 (Fed. Cir. 1997). Further, a claim fails to satisfy the written description requirement if "the entirety of the specification clearly indicates that the invention is of much narrower scope." *Cooper Cameron Corp. v. Kvaerner Oilfield Prods., Inc.*, 291 F.3d 1317, 1323 (Fed. Cir. 2002) (citing *Gentry Gallery, Inc. v. Berkline Corp.*, 134 F.3d 1473, 1479–80 (Fed. Cir. 1998)).

The specification clearly indicates that the alleged invention is of much narrower scope than what Capella accuses in its Infringement Contentions. The specification explained that "[a] distinct feature" of the alleged invention was that "each channel micromirror" was "individually controllable and moveable, e.g., continuously pivotable (or rotatable):

> In operation, a multi-wavelength optical signal emerges from the input port. The wavelength-separator separates the multi-wavelength optical signal into multiple spectral channels, each characterized by a distinct center wavelength and associated bandwidth. The beam-focuser focuses the spectral channels into corresponding spectral spots. The channel micromirrors are positioned such that each channel micromirror receives one of the spectral channels. ***The channel micromirrors are individually controllable and movable, e.g., continuously pivotable (or rotatable), so as to reflect the spectral channels into selected ones of the output ports***. As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror". And each output port may receive any number of the reflected spectral channels.
>
> A distinct feature of the channel micromirrors in the present invention, in contrast to those used in the prior art, is that ***the motion, e.g., pivoting (or rotation), of each channel micromirror is under analog control such that its pivoting angle can be continuously adjusted***. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port.

’905 Patent at 4:19–23 (emphasis added). In its Infringement Contentions, however, Capella has accused “LCoS-based switching modules” of satisfying various “beam-deflecting elements” and “channel micromirrors” phrases. Capella describes these “LCoS-based switching modules” as follows:

> The LCoS-based switching modules use a matrix of phase controlled pixels to create a spatial array of channel micromirrors. ***The width of each channel micromirror is controlled by varying the number of pixel columns selected in a first (e.g., horizontal) direction. Channel reflection into a selected fiber collimator output port is controlled by pivoting fibers within the pixels in a second direction (e.g., in a vertical column) and creating optical phase retardation in the direction of the intended deflection.*** The switching module controls beam deflection and optical power by varying the pitch and blaze of the pixels in the columns thereby creating grating patterns. The LCoS array is able to dynamically and continuously control beam reflection and power, dispersion, phase and amplitude. The LCoS is also able to perform additional filter functions.

E.g., Infringement Contentions at 74-75 (emphasis added) (native PDF pagination). Based on Capella’s own description, the “LCoS-based switching modules” themselves are not capable of “motion, e.g., pivoting (or rotation).” There is no disclosure or mention in the Asserted Patents of an “LCoS-based switching module” or even an LCoS array. The specifications of the Asserted Patents do not even include the words Liquid Crystal on Silicon (LCoS) or liquid crystal. The specification demonstrates that the named inventors were not in possession of an apparatus, system, or method that used “LCoS-based switching modules.” Every embodiment describing the “channel micromirrors” describes them as being movable/rotatable/pivotable about one or two axes:

> This invention provides a novel wavelength-separating-routing (WSR) apparatus that uses a diffraction grating to separate a multi-wavelength optical signal by wavelength into multiple spectral channels, which are then focused onto an array of corresponding channel micromirrors. ***The channel micromirrors are individually***

> ***controllable and continuously pivotable*** to reflect the spectral channels into selected output ports.

Id., Abstract (emphasis added).

> In the WSR apparatus of the present invention . . . ***each channel micromirror may be pivotable*** about one or two axes."

Id. at 4:27–37 (emphasis added).

> The channel micromirrors 103 are individually controllable and ***movable, e.g., pivotable (or rotatable) under analog (or continuous) control***, such that, upon reflection, the spectral channels are directed into selected ones of the output ports 110-2 through 110-N by way of the focusing lens 102 and the diffraction grating 101. As such, each channel micromirror is assigned to a specific spectral channel, hence the name "channel micromirror".

Id. at 7:20–27 (emphasis added).

> Depicted in FIG. 1B is a close-up view of the channel micromirrors 103 shown in the embodiment of FIG. 1A. By way of example, the channel micromirrors 103 are arranged in a one-dimensional array along the x-axis (i.e., the horizontal direction in the figure), so as to receive the focused spots of the spatially separated spectral channels in a one-to-one correspondence. (As in the case of FIG. 1A, only three spectral channels are illustrated, each represented by a converging beam.) ***Let the reflective surface of each channel micromirror lie in the x-y plane as defined in the figure and be movable, e.g., pivotable (or deflectable) about the x-axis in an analog (or continuous) manner***. Each spectral channel, upon reflection, is deflected in the y-direction (e.g., downward) relative to its incident direction, so to be directed into one of the output ports 110-2 through 110-N shown in FIG. 1A.
>
> As described above, a unique feature of the present invention is that the motion of ***each channel micromirror is individually and continuously controllable, such that its position, e.g., pivoting angle, can be continuously adjusted***. This enables each channel micromirror to scan its corresponding spectral channel across all possible output ports and thereby direct the spectral channel to any desired output port. To illustrate this capability, FIG. 1C shows a plot of coupling efficiency as a function of a channel micromirror's pivoting angle Θ, provided by a ray-tracing model of a WSR apparatus in the embodiment of FIG. 1A.

Id. at 8:22–45 (emphasis added).

> The channel micromirrors may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting elements known in the art. And ***each micromirror may be pivoted about one or two axes. What is important is that the pivoting (or rotational) motion of each channel micromirror be individually controllable in an analog manner***, whereby the pivoting angle can be continuously adjusted so as to enable the channel micromirror to scan a spectral channel across all possible output ports.

Id. at 9:22–31 (emphasis added).

> FIG. 3 shows a fourth embodiment of a WSR apparatus according to the present invention. By way of example, WSR apparatus 300 is built upon and hence shares a number of the elements used in the embodiment of FIG. 2B, as identified by those labeled with identical numerals. In this case, the one-dimensional fiber collimator array 110 of FIG. 2B is replaced by a two-dimensional array 350 of fiber collimators, providing for an input-port and a plurality of output ports. Accordingly, the one-dimensional collimator-alignment mirror array 220 of FIG. 2B is replaced by a two-dimensional array 320 of collimator-alignment mirrors, and first and second one-dimensional arrays 260, 270 of imaging lenses of FIG. 2B are likewise replaced by first and second two-dimensional arrays 360, 370 of imagining lenses respectively. As in the case of the embodiment of FIG. 2B, the first and second two-dimensional arrays 360, 370 of imaging lenses are placed in a 4-f telecentric arrangement with respect to the two-dimensional collimator-alignment mirror array 320 and the two-dimensional fiber collimator array 350. ***The channel micromirrors 103 must be pivotable biaxially in this case (in order to direct its corresponding spectral channel to any one of the output ports)***. As such, the WSR apparatus 300 is equipped to support a greater number of the output ports.

Id. at 10:44–67 (emphasis added). Accordingly, the entirety of the specification demonstrates that the alleged invention required that each of the "channel micromirrors" be moveable/pivotable/rotatable. Because each accused "LCoS-based switching module" is *not* itself moveable/pivotable/rotatable, the Asserted Claims fail to satisfy the written description requirement if the scope of the claims is interpreted to encompass an "LCoS-based switching module." For example, if the proper construction of the following limitations under *Phillips* does

not require that the recited "channel micromirrors" or "beam-deflecting elements" be moveable/pivotable/rotatable (or moved/pivoted/rotated), the Asserted Claims are invalid for failing to satisfy the written description requirement, along with all claims that depend on the identified Asserted Claims that similarly fail to require that the recited "channel micromirrors" or "beam-deflecting elements" be moveable/pivotable/rotatable (or moved/pivoted/rotated):

Claim Terms	Asserted Claims
"a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port"	'905 Patent, Claim 23
"a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports and to control the power of the spectral channel reflected to said output port of the fiber collimator serving as said selected port, whereby a subset of said spectral channels is directed to said fiber collimator serving as said drop ports"	'905 Patent, Claim 47
"a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports and to control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port, whereby said spectral channels from said fiber collimators serving as said add ports are selectively provided to said output port"	'905 Patent, Claim 49
"controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal"	'905 Patent, Claim 51

Claim Terms	Asserted Claims
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports"	'906 Patent, Claim 68
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said fiber collimator output ports"	'906 Patent, Claim 89
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually and continuously controllable to reflect said spectral channels into selected ones of said output ports"	'906 Patent, Claim 100
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels"	'906 Patent, Claim 115
"a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors"	'906 Patent, Claim 126
"dynamically and continuously controlling said beam-deflecting elements in two dimensions to direct said spectral channels into any selected ones of output ports and to control the power of the spectral channels coupled into said selected output ports"	'906 Patent, Claim 133

A claim also fails to satisfy the written description requirement if, at a minimum, the specification does not describe a negative claim limitation as an alternative feature of the invention. *Inphi Corp. v. Netlist, Inc.*, 805 F.3d 1350, 1356 (Fed. Cir. 2015). Several Asserted Claims recite

negative limitations, but the specification fails to describe these limitations as alternative features of the invention, and fails to otherwise demonstrate that the named inventors were in possession of these features. Accordingly, the following claims fail to satisfy the written description requirement, along with any claims dependent on the identified Asserted Claims:

Claim Terms	Asserted Claims
"none of the multi-wavelength optical signal, the second spectral channels, or the output multi-wavelength optical signal are transmitted through a circulator"	'905 Patent, Claim 37
"none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"	'905 Patent, Claim 48
"none of the input or output multi-wavelength optical signal or the spectral channels are transmitted through a circulator"	'905 Patent, Claim 50
"neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"	'906 Patent, Claim 88
"neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"	'906 Patent, Claim 99
"neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"	'906 Patent, Claim 106
"neither said multi-wavelength optical signal nor said spectral channels are transmitted through a circulator"	'906 Patent, Claim 132

The specification also states that "other types of beam-deflecting elements known in the art" are a type of "micromirror." *See* '905 Patent at 9:22–25. But claim 46 of the '905 Patent purports to limit "beam-deflecting elements" to "micromirrors," apparently implying that "beam-deflecting elements" are *broader* than micromirrors. Similarly, claim 35 of the '905 Patent purports to limit "beam-deflecting elements" to "micromachined mirrors." To the extent "beam-deflecting elements" are interpreted as broader than micromirrors or micromachined mirrors, the specification does not demonstrate that the named inventors were in possession of the full scope of the alleged invention, the following claims are invalid for failing to satisfy the written description requirement, along with all claims that depend on these Asserted Claims:

Claim Terms	Asserted Claims
"beam-deflecting elements"	'905 Patent, Claims 23, 47, 49, 51 '906 Patent, Claim 133

C. Lack of Enablement

Various Asserted Claims are invalid for failure to comply with the enablement requirement under pre-AIA 35 U.S.C. § 112, ¶ 1. To satisfy the enablement requirement of 35 U.S.C § 112, ¶ 1, the disclosure "must teach those skilled in the art how to make and use the full scope of the claimed invention without 'undue experimentation.'" *Sitrick v. Dreamworks, LLC*, 516 F.3d 993, 999 (Fed. Cir. 2008). Moreover, "[i]t is the specification, not the knowledge of one skilled in the art that must supply the novel aspects of the invention in order to constitute adequate enablement." *Genentech, Inc. v. Novo Nordisk A/S*, 108 F.3d 1361, 1366 (Fed. Cir. 1997). The Federal Circuit has enumerated several factors to consider in determining whether a disclosure would require "undue experimentation": (1) the quantity of experimentation necessary; (2) the amount of direction or guidance presented; (3) the presence or absence of working examples; (4) the nature of the invention; (5) the state of the prior art; (6) the relative skill of those in the art; (7) the predictability or unpredictability of the art; and (8) the breadth of the claims. *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988).

As noted above in discussing the written description requirement, the specification discloses to a person of ordinary skill of the art that each of the channel micromirrors are able to move/rotate/pivot in or to direct its respective spectral channel to "any one of the output ports." The specification fails to disclose any embodiment in which the channel micromirrors do not move/rotate/pivot to accomplish that goal. Accordingly, to the extent the scope of the claims is not limited such that "channel micromirrors" or "beam-deflecting elements" be

moveable/pivotable/rotatable (or moved/pivoted/rotated), the Asserted Claims are invalid for failing to satisfy the enablement requirement, along with all claims that depend on the identified Asserted Claims that similarly fail to require that the recited "channel micromirrors" or "beam-deflecting elements" be moveable/pivotable/rotatable (or moved/pivoted/rotated), because the written description fails to teach those skilled in the art how to make and use the full scope of the claimed invention without undue experimentation:

Claim Terms	Asserted Claims
"a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator ports and to control the power of the spectral channel reflected to said output port or the fiber collimator selected port"	'905 Patent, Claim 23
"a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimators serving as said ports and to control the power of the spectral channel reflected to said output port of the fiber collimator serving as said selected port, whereby a subset of said spectral channels is directed to said fiber collimator serving as said drop ports"	'905 Patent, Claim 47
"a spatial array of beam-deflecting elements positioned such that each element receives a corresponding one of said spectral channels, each of said elements being individually and continuously controllable in two dimensions to reflect its corresponding spectral channel to a selected one of said output port or the fiber collimator serving as said ports and to control the power of the spectral channel reflected to said output port or said fiber collimator serving as said selected port, whereby said spectral channels from said fiber collimators serving as said add ports are selectively provided to said output port"	'905 Patent, Claim 49
"controlling dynamically and continuously said beam-deflecting elements in two dimensions so as to combine selected ones of said spectral channels into an output multi-wavelength optical signal and to control the power of the spectral channels combined into said output multi-wavelength optical signal"	'905 Patent, Claim 51

Claim Terms	Asserted Claims
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said fiber collimator output ports and to control the power of said received spectral channels coupled into said fiber collimator output ports"	'906 Patent, Claim 68
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually controllable to reflect said spectral channels into selected ones of said fiber collimator output ports"	'906 Patent, Claim 89
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being individually and continuously controllable to reflect said spectral channels into selected ones of said output ports"	'906 Patent, Claim 100
"a spatial array of channel micromirrors positioned such that each channel micromirror receives one of said spectral channels, said channel micromirrors being pivotal about two axes and being individually and continuously controllable to reflect corresponding received spectral channels into any selected ones of said output ports and to control the power of said received spectral channels coupled into said output ports, whereby said fiber collimator pass-through port receives a subset of said spectral channels"	'906 Patent, Claim 115
"a spatial array of auxiliary channel micromirrors; wherein said subset of said spectral channels in said fiber collimator pass-through port and one or more add spectral channels are directed into said fiber collimator auxiliary input ports, and multiplexed into an output optical signal directed into said exiting port by way of said auxiliary wavelength-separator, said auxiliary beam-focuser and said auxiliary channel micromirrors"	'906 Patent, Claim 126
"dynamically and continuously controlling said beam-deflecting elements in two dimensions to direct said spectral channels into any selected ones of output ports and to control the power of the spectral channels coupled into said selected output ports"	'906 Patent, Claim 133

VI. ADDITIONAL GROUNDS OF INVALIDITY AND/OR UNENFORCEABILITY

Although not required by Patent L.R. 3-3 or the Court's Standing Order Regarding Subject Matter Eligibility Contentions, FNC discloses the following additional theories of invalidity and/or

unenforceability of the Asserted Patents and/or the Asserted Claims. FNC reserves the right to identify additional theories of invalidity and/or unenforceability not required by Patent L.R. 3-3 and to supplement the additional theories identified herein based on further investigation and discovery.

A. Invalidity Under Pre-AIA 35 U.S.C. § 112, ¶ 4

A dependent claim must "contain a reference to a claim previously set forth and then specify a further limitation of the subject matter claimed." Pre-AIA 35 U.S.C. § 112, ¶ 4. A dependent claim's failure to comply with this provision invalidates the claim. *See Pfizer, Inc. v. Ranbaxy Labs. Ltd.*, 457 F.3d 1284, 1292 (Fed. Cir. 2006).

Claims 35 and 46 of the '905 Patent are invalid because they are dependent claims that fail to "specify a further limitation of the subject matter claimed." The specification explains that "[t]he *channel micromirrors* may be provided by silicon micromachined mirrors, reflective ribbons (or membranes), or other types of beam-deflecting elements known in the art." '905 Patent at 9:22–25. In other words, the specification describes "micromirrors" as a genus and "other beam-deflecting elements" as a species within that genus. By purporting to limit "beam-deflecting elements" to "micromachined mirrors" and "micromirrors," Claims 35 and 46 of the '905 Patent respectively fail to specify a further limitation because they fail to add anything at all (because "beam-deflecting elements" are already by definition "micromirrors" or "micromachined mirrors"), and appear to be an attempt to *broaden* the claim by treating "beam-deflecting elements" as a genus instead of as a species of "micromirrors" or "micromachined mirrors."

B. Improper Reissue

The '905 or '906 patents are invalid, in whole or in part, for failure to meet 35 U.S.C. § 251 et seq.

C. Collateral Estoppel and Res Judicata

In 2016, the Patent Trial and Appeal Board ("PTAB") issued several Final Written Decisions based on Petitions for *Inter Partes Review* ("IPRs") that were filed challenging certain claims of the predecessor '368 and '678 Patents. *See* Exs. 3-8. The PTAB found that a number of claims in the predecessor '368 and '678 Patents were invalid pursuant to 35 U.S.C. § 103 based on various prior art references and cancelled those claims. On February 12, 2018, the Federal Circuit summarily affirmed these decisions in *Capella Photonics, Inc. v. Cisco Systems, Inc.*, *Ciena Corp.*, *Coriant Operations, Inc.*, *Coriant (USA) Inc.*, *Fujitsu Network Communications, Inc.*, *Lumentum Holdings, Inc.*, *Lumentum Inc.*, *Lumentum Operations, LLC*, Nos. 2016-2394, 2016-2395, 2017-1105, 2017-1106, 2017-1107, 2017-1108. *See* Ex. 13. On April 16, 2018, the Federal Circuit issued its mandate. *See* Ex. 14. On November 5, 2018, the United States Supreme Court denied a Petition for Writ of Certiorari filed by Capella. *See* Ex. 15. Accordingly, the PTAB's Final Written Decisions and the Federal Circuit's affirmance of those decisions are final and non-appealable. In its Complaint, Capella alleges that "[o]ne or more claims of the '905 patent is substantially identical to one or more claims of the original '368 patent" (Dkt. No. 1, ¶ 21), and that "[o]ne or more claims of the '906 patent is substantially identical to one or more claims of the original '678 patent" (*id.*, ¶ 24). According to Capella, one or more claims of the '905 Patent is substantially identical or substantially similar to one or more claims of the '368 Patent that was invalidated by the PTAB, and/or one or more claims of the '906 Patent is substantially identical or substantially similar to one or more claims of the '678 Patent that was invalidated by the PTAB. Accordingly, Capella is collaterally estopped from challenging the invalidity of such claims. Dkt. No. 31-30 Order Granting Plaintiff's Motion for Judgment on the Pleadings (Aug. 21, 2020), *Cisco Sys., Inc. v. Capella Photonics, Inc.*, No. 20-01858 (N.D. Cal.) at 11 ("Accordingly, if the scope of the reissue claims is substantially identical to the scope of the original claims, those

claims would be invalid under principles of collateral estoppel."). Capella is also collaterally estopped from challenging determinations necessary to support the PTAB's judgments in the IPRs, including, for example and without limitation, determinations by the PTAB that (1) certain materials are prior art, (2) disclosures from certain materials teach certain claim limitations, and/or (3) a person of ordinary skill in the art would have been motivated to combine certain teachings.

Further, to the extent that any claims in the '905 and '906 Patents are deemed substantially identical to claims in the '368 and '678 Patents that were not invalidated in IPR proceedings, Capella could have asserted such claims in the prior lawsuit and is barred from asserting such claims under the doctrine of res judicata.

D. Patent Owner Estoppel

In 2016, the Patent Trial and Appeal Board ("PTAB") issued several Final Written Decisions based on Petitions for *Inter Partes Review* that were filed challenging certain claims of the '368 and '678 Patents. The PTAB found that a number of claims in the predecessor '368 and '678 Patents were invalid pursuant to 35 U.S.C. § 103 based on various prior art references and cancelled those claims. Accordingly, pursuant to 37 C.F.R. § 42.73(d)(3), Capella was and is "precluded from taking action inconsistent with the adverse judgment." This preclusion includes, but is not limited to, "obtaining in any patent . . . [a] claim that is not patentably distinct from a finally refused or cancelled claim[.]" In its Complaint, Capella alleges that "[o]ne or more claims of the '905 patent is substantially identical to one or more claims of the original '368 patent[]" (Dkt. No. 1, ¶ 32), and that "[o]ne or more claims of the '906 patent is substantially identical to one or more claims of the original '678 patent[]" (*id.*, ¶ 35). According to Capella, one or more claims of the '905 Patent is not patentably distinct from one or more claims of the '368 Patent that was cancelled by the PTAB, and/or one or more claims of the '906 Patent is not patentably distinct from one or more claims of the '678 Patent that was cancelled by the PTAB. Accordingly, (1) such

claims are invalid because Capella was estopped from obtaining them from the United States Patent Office and (2) Capella was and is precluded from taking any further action inconsistent with the adverse judgment. As a result, for example and without limitation, Capella is estopped from challenging the invalidity of such claims, and/or Capella is estopped from challenging determinations necessary to support the PTAB's judgments in the IPRs, including, for example and without limitation, determinations by the PTAB that (1) certain materials are prior art, (2) disclosures from certain materials teach certain claim limitations, and/or (3) a person of ordinary skill in the art would have been motivated to combine certain teachings.

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Respectfully submitted,

By: */s/ Nathaniel T. Browand*

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CERTIFICATE OF SERVICE

I hereby certify that counsel of record who are deemed to have consented to electronic service are being served with a copy of the foregoing document Defendant Fujitsu Network Communications, Inc.'s Initial Invalidity Contentions by electronic mail on September 25, 2020.

By: *<u>/s/ Nathaniel T. Browand</u>*
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